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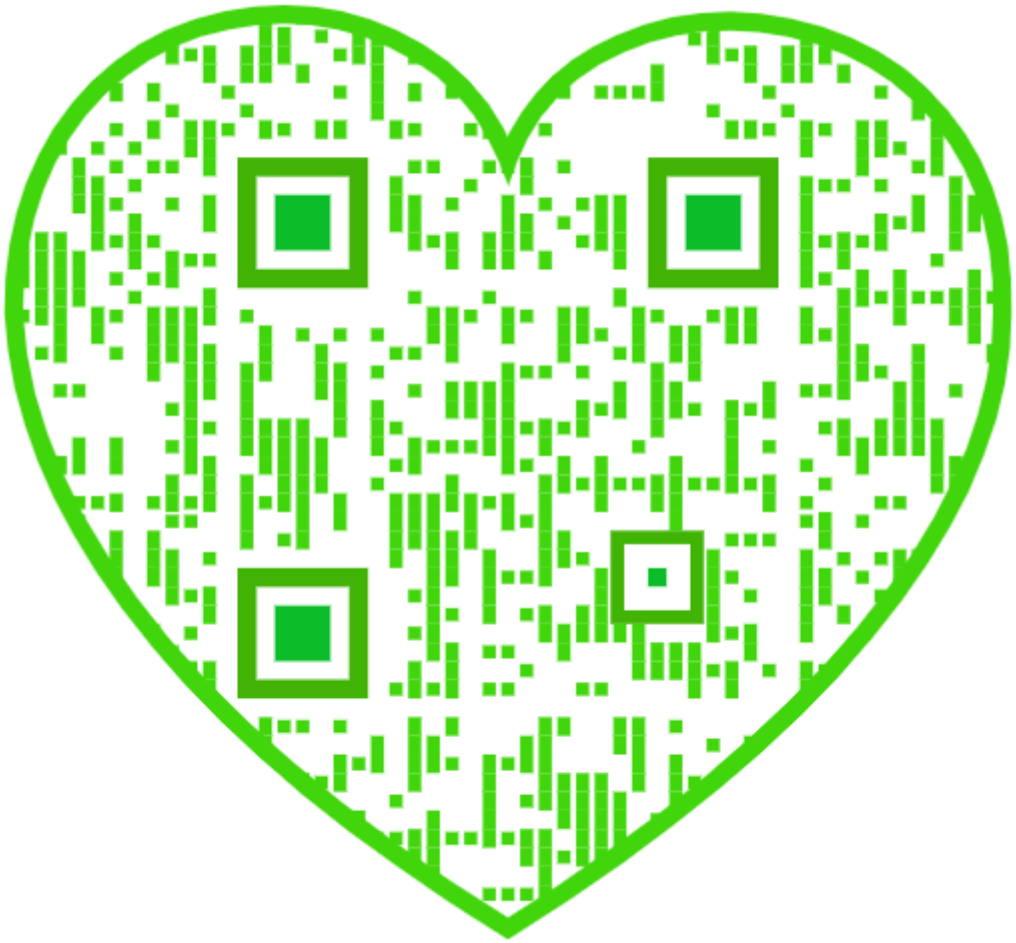

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Tree Wounds and Diseases

[*Frontispiece, see pages* 4 *and* 35.

"WILBERFORCE" OAK AFTER TREATMENT.

Tree Wounds and Diseases

THEIR PREVENTION AND TREATMENT

WITH A SPECIAL CHAPTER ON

FRUIT TREES

BY

A. D. WEBSTER

AUTHOR OF
"PRACTICAL FORESTRY," "THE FORESTER'S DIARY," ETC.

WITH 32 FULL-PAGE PLATES AND OTHER ILLUSTRATIONS

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PREFACE

THE reasons for writing this book are: (1) that no work of a similar kind has been published; (2) that numerous inquiries as to the treatment of tree wounds and diseases suggest that such a book is required; and (3) the writer's knowledge of the subject, the result of many years' practical work and observation, has caused him to relate his experiences in the matter.

The book, too, has been written by special request, and an apology is due for its non-appearance three years ago, as arranged. Unforeseen circumstances, however, prevented this being done.

A. D. WEBSTER.

REGENT'S PARK, N.W.,
1916.

INTRODUCTION

Though no book dealing exclusively with tree wounds and diseases has been written, yet references are not wanting, in ancient as well as modern works, to the doctoring of fruit and other trees. In Evelyn's *Sylva*, published in 1670, under the heading of "Infirmities of Trees," some quaint instructions are given regarding the treatment of canker, hollowness, wind-shock, blasting, and caterpillars. "Hollowness," he says, "is contracted when by reason of the ignorant or careless lopping of a tree the wet is suffered to fall perpendicularly upon a part, especially the head. In this case, if there be sufficient sound wood, cut it to the quick and close to the body, and cap the hollow part with a tarpaulin or fill it with good stiff loam and fine hay mingled. This is one of the worst of evils, and to which the Elm is most

obnoxious." Again: "Cankers, caused by some stroke or galling, are to be cut out to the quick, the scars emplaistered with tar mingled with oil, and over that a thin spreading of loam; or else with clay and horse dung, but best with hog's dung alone."

Miller, in his *Gardener's Dictionary*, published in 1737, and Dicks, in a work bearing the same title which appeared thirty years later, refer to wounds and diseases in forest and fruit trees; while Forsyth and Pontey, who wrote about the beginning of last century, would appear to have followed Evelyn in their methods of dealing with injuries to stem and branch. The Government made a grant of £3000 to Forsyth on condition of his making public the secret of his composition for repairing injuries to the stems of trees. The said composition consisted of fresh cow-dung, old lime, wood ashes, and sand, dusted over with the ashes of burnt bones. Though, perhaps, little can be said in favour of such a dressing, yet his directions for the cutting and scooping out of decayed wood and protecting the wound until covered with fresh bark are worthy of all com-

mendation. But earlier than any of these writers, at the beginning of the fourteenth century, we find at least two curious and interesting notes as to the treatment of diseased orchard trees. All this points out that from an early date the subject-matter of this book had received at least some attention.

It is only, however, of late years that the systematic treatment of tree wounds and diseases has been adopted, by the filling of hollow trunks, bracing of heavy and diseased branches, and attention to insect and fungoid attacks. But even at the present time these operations are but little understood, and in many instances are carried out in an antiquated and slipshod manner, the result of ignorance as to the most approved methods to be adopted in dealing with the exigencies of each individual case.

The study and treatment of tree wounds and diseases is, perhaps, the most interesting and fascinating of any in the whole range of forest science. Why a tree becomes unhealthy or dies off prematurely ; why certain species are infested with a particular insect or fungus to, in certain cases, the exclusion of all others ; how

to account for rusty, meagre, and unhealthy leafage, stagheadedness, bark-shedding, and hollow trunk, are all questions of importance that must forcibly appeal to everyone who is interested in the welfare of park and woodland trees.

The sudden and unexpected death of a tree may be due to several causes, such as want of or excessive moisture in the soil, atmospheric impurities, or an escape of gas amongst the soil in which the tree is growing. Stagheadedness usually comes about gradually, and may be attributed to old age, unsuitable soil and surroundings, or a generally enfeebled condition of the tree; while bark-shedding may and usually does accompany any of the above conditions and may also be directly due to frost and insect or fungus attacks. Wounds are, however, the chief cause of the unhealthy condition of a tree, and, if not attended to at the outset, quickly become tenanted by fungus and insect pests, which rapidly sap the life of the tree and eventually bring about its partial or entire destruction. The causes of wounds are many, the principal being: injury to stem or branch

during stormy weather, effects of lightning, careless felling and removal of timber, the grazing of farm stock, insect attacks, and in the case of lawn and park trees is often traceable to the mowing machine, horse-roller, or tools of the careless workman.

Fungi rarely attack healthy trees, but when the bark is injured and the wood exposed they find a suitable medium and quickly bring about a diseased condition which, if not promptly attended to, will, in certain instances at least, result in the death of the affected tree. They vary much in size, from the almost microscopical parasites to the beef-steak fungus, which latter, under favourable conditions, will attain to a diameter of two or more feet and occur in groups of a dozen or more, arranged in their curious shelf-like order on the tree stem. It is quite common to find this and another nearly allied species growing on the stems of the elm and oak at a height of thirty or forty feet from the ground, while on the same tree not a specimen can be detected nearer ground level, which points to the fact that the spores are carried to a great height,

and warns us that damage caused by the accidental breaking of a branch, even near the tree top, should receive prompt and careful attention. Root fungi are difficult to detect, and attack healthy and diseased trees alike; but, where no visible signs of the pest are traceable on branch or stem, a careful examination of the roots is recommended.

Though insect attacks are in the main confined to unhealthy trees, yet this is not always the case, as instance the widespread depredations of the pine beetle and pine weevil and the goat and wood leopard moths. On the other hand, the elm bark beetle attacks unhealthy trees, while many pests of the orchard can only gain a footing when damage to the bark or stem has been brought about by accident or otherwise.

Hollow-stem usually accompanies old age or the natural decline of a tree, though in some instances it may be directly traceable to disease brought about by unsuitable soil conditions, as in the case of "pumping" or heart-rot in the larch when grown on gravel.

These include a few of the many wounds and

diseases to which trees are liable, and for which the most approved remedies are suggested in the following chapters.

This book is written with the distinct object in view of bringing home to owners of trees, or those in charge of such, that, at a small outlay of labour and expense, the life-time of old, historic, or accidentally damaged specimens may be greatly extended. From personal experience, it is quite clear that the work of tree repair is but rarely engaged in and little understood, and in the following chapters the aim has been to give the necessary information for carrying out such operations in as clear and concise a manner as possible. The illustrations will, it is hoped, assist in elucidating doubtful matter. As showing the interest that is at present being taken in connection with the rapid spread of tree pests, it may be mentioned that the Governors of the North of Scotland College of Agriculture and Forestry are offering prizes for approved collections and specimens illustrative of the damage done to forest trees by fungi, insects, mammals, and birds. Three of the illustra-

tions—beech coccus, sycamore leaf fungus, and eggs of the gooseberry leaf sawfly—are from the *Journal of the Board of Agriculture*; those of "shakes" in timber from Laslett, and that of the heather beetle by permission of the Secretary of Investigation Committee. To all, indebtedness is acknowledged and thanks returned.

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TREE WOUNDS AND DISEASES

CHAPTER I

THE MANAGEMENT OF DECAYING TREES

When the value of old trees in an ornamental or utilitarian sense is taken into account, it is remarkable what a small amount of attention they receive when subjected to accident or disease. In the great majority of cases, injury to root, stem, or branch is the direct cause of decay, and this is particularly the case with old trees, the generally enfeebled condition of which greatly facilitates the spread of disease.

Branches that have been broken over by the wind are undoubtedly the main cause of decay, though injuries to the root or stem, as by frost, lightning, timber haulage, or other accidents, are fertile means of bringing about a diseased and unhealthy condition of the

trees. Various other causes, too, contribute to the same result, such as atmospheric conditions, poverty or poisoning of the soil, excessive dampness, all of which, if not rectified in time, soon lay the foundation for a host of other diseases, such as heart-rot, stagheadedness, rust and mildew, and the development of many species of fungi, the devastating inroads of any of which may in many cases be prevented, or at least lessened, by timely care and the application of suitable remedies judiciously applied according to the requirements and circumstances of the particular case.

A plate of lead or zinc, a dressing of tar, or the filling up of a cavity with suitable composition will often, and at a minimum of expense, preserve a desirable specimen from falling into too rapid decay ; while a properly adjusted chain or brace will go far in preventing an unwieldy or diseased branch from being broken over by the wind. In cases where the soil has become caked and impoverished and the vital energy of the tree impaired thereby, a dressing of rich loam or other suitable soil

will go far in restoring the time-honoured specimen to its wonted vigour; while the removal by drainage of excessive moisture has a most beneficial effect on the health of the majority of our woodland trees.

The preservation of venerable tree growth is surely a duty that is incumbent on all owners of estates or custodians of our public parks and gardens. Of late years in particular, our ruined castles and ecclesiastical buildings have received much attention in the matter of preventing them falling into decay or being carried away piecemeal for the erection of farm walls and buildings. It is equally if not more desirable that our old and historic trees should be well cared for, whether by root-feeding, stem-protecting, or sheltering from inclement weather the hollow, decaying trunks of remarkable specimens. When the bark and portions of the wood are alive, it is quite possible by judicious management to throw fresh vigour into some of these old denizens of the forest, and thus render them objects of interest for a prolonged period of time.

Fortunately, we have examples of the good effects of repairing old and historic trees, and notable instances of this kind may be pointed out in the "Wilberforce" and "Pitt" oaks at Holwood, in Kent, as also others of the same kind on the Woburn and Welbeck estates, and in other parts of the country. But even when dead and reduced to stumps with a few straggling, fragile branches atop, it is quite possible to preserve the remains for a lengthened period by careful bracing or by chaining the heavy limbs together, and by reducing the weight of such portions as cannot well be artificially stayed or supported. The lifetime of many trees has been greatly prolonged, and their natural beauty retained, by timely attention in the matter of supporting heavy limbs and branches that were likely to become detached during stormy weather, and, as the doing of such work costs but little, there is no reason why the operation should not be greatly extended.

To the dweller in our larger towns and cities, the welfare and preservation of trees is of vast importance. Town trees are particu-

"WILBERFORCE" OAK BEFORE TREATMENT.

DECAYING TREES IN BURNHAM BEECHES.

larly liable to injury and disease, for not only have they to do battle above ground with a chemically impure atmosphere, but in many instances the soil, composed largely of broken bricks, clinkers, and gravel, is surcharged with gaseous matter and ill fitted for maintaining a healthy condition of tree life.

The encroachments of the builder have caused whole forests of ancient trees to disappear of late years, and many of the remaining specimens have become so injured and diseased by drainage and excavation operations that, in both urban and suburban districts, one-half of the older trees are either dead or dying. Gas, drainage, and other pipes have much to answer for beneath ground ; but the carelessness of the builder, teamster, and road-maker is also responsible for the decay and death of many a noble tree.

But equally bad, though perhaps less important, is the condition of many trees in our older forests and woodlands. We have only to examine the occupants of such places as Epping Forest, Sherwood, Burnham Beeches, or the remains of the old Kentish and other

forests to find how many historic and otherwise valuable trees are crumbling to ruin for want of timely attention in the matter of pruning, bracing, or filling the cavities of both branch and stem. Both in public and private parks, the latter in particular, the attention bestowed on injured and diseased trees is scant indeed, and leads one to believe that in the art of tree-surgery we are but little advanced from what the writers on orchard trees make us believe was the case three and a half centuries ago. As stated elsewhere, it cannot, however, be expected that all hollow and diseased trees in our larger wooded areas should receive attention, but in the case of historic specimens, those growing in towns and in our public and private parks, the bracing of heavy limbs and treatment of hollow trunks should be considered as imperative.

But it is not only old trees that suffer from disease and decay, for in the case of young plantations the attacks of insects and fungi are often most destructive to the occupants. The larch falls a speedy prey to that most insidious disease the larch canker, while the

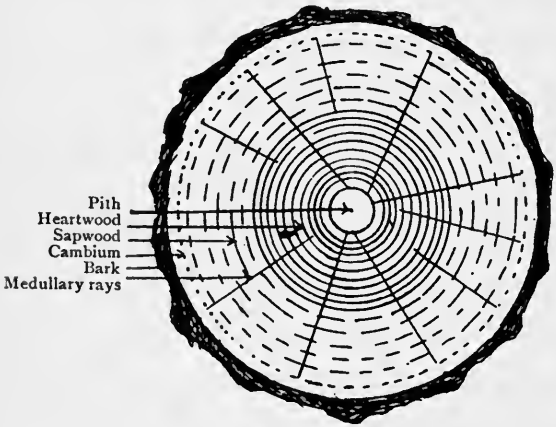
Scotch pine is attacked in a wholesale manner by the pine beetle, and whole beech woods have been destroyed by a species of coccus which, of late years, has been alarmingly on the increase in this country.

Every tree is perhaps liable to some accident, disease, or malady, and the object of the present work is to direct attention to some of the most serious, and, if possible, suggest suitable remedies.

Though as far as possible popular names are used in describing the various parts of a tree, yet, to the uninitiated, the meaning of such terms as pith, cambium, and medullary rays may not be understood, and to aid the reader the following notes and diagram of the cross-section of a tree stem are added. On examining a piece of timber it will be found to consist of (1) the bark or cortex, (2) cambium, (3) sapwood or alburnum, (4) heartwood, and (5) the central pith ; in addition to which there are the annual rings and medullary rays.

The pith, or central part of the stem, which is composed of cellular tissue, is relatively large in young plants, but does not increase

in size with the growth of the tree. In some trees, as the elder, the pith is out of all proportion to the surrounding wood; while in mature oak it is hardly discernible, appearing in the form of a dry, powder-like mass. Radiating from the pith to the bark and pre-



Cross-section of a tree stem.

senting a star-like appearance are the medullary rays, or "silver-grain" of the carpenter, and it is to the breaking up or crossing of these rays that we owe the beautiful graining of oak and other timbers. Around the pith will be seen a series of consecutive lines or perfect layers, which are the annual rings of wood, the number of which will determine the age of the tree.

The timber next the pith is described as heartwood or duramen, which is harder and darker in colour than the other portions of the stem. Outside this is the sapwood or alburnum, which may best be described as young or immature wood, and is softer and lighter in weight and colour than the heartwood. Between the sapwood and bark is the cambium, which may be described as a thin and delicate tissue or layer of active cells containing the nutritive materials required as food by the tree. It must be looked upon as the real active part of a tree, in that it transmits the sap from the roots to the crown.

Everyone knows what the bark is, the main use being to protect the cambium and wood. With the elm, birch, oak, poplar, and such-like rough-barked trees, the bark growth is annually added to from within, the outer surplus layers gradually flaking off owing to pressure caused not only by bark expansion but by the growth of the timber. From smooth-barked trees like the hornbeam and beech a deeply furrowed outer covering is absent, as in these cases the bark itself grows and expands.

CHAPTER II

HOLLOW TRUNKS AND THEIR TREATMENT

It may be laid down as a general principle that when left to themselves cavities or hollows in trees gradually increase in size until the ascending sap is entirely cut off, when the crumbling stem either falls to pieces or is broken over by the wind. Hollows and cavities, with their usual accompaniments, may therefore be looked upon as the primary and main cause of a tree's destruction, and as a direct connecting stage between the injured bark and dead or dying stem. Little wonder, then, that the best art of the woodman has been brought to bear on the vital point of arresting decay, whether by a timely filling of concrete, covering apertures so as to prevent the ingress of damp, or treating antiseptically for insect and fungoid diseases, as the exigency of the parti-

cular case may demand. Cavities and hollows in tree stems are particularly favourable for insect and fungus attacks, not only on account of the shade and dampness, but because of the protection that is afforded from drying winds and cold, all of which are ideal conditions for the growth and development of these timber-destroying agents.

It is well to bear in mind that hollows in trees are filled with several distinct objects in view. These are: (1) to arrest decay by removing the cause, such as insect and fungoid attack and the ingress of damp; (2) by an application of tar, creosote, or paint to prevent the entrance of these wood-destroyers and to aid in healing the wound; (3) to strengthen the stem or branch so that it may be better able to withstand strong winds; and (4) for the sake of appearance.

Small holes in trunk or branch, such as have been brought about by a falling branch or other accident, or the remains of a snag or wrong system of pruning, may all, at little cost, be successfully dealt with. The removing of rotten wood, painting the surface with

tar or other protective composition, and filling with cement will usually put matters right in preventing the spread of decay and aiding in the callusing over and healing of the wound.

But, however desirable it may be to repair hollow trunks, yet a great amount of discrimination is necessary in deciding which trees

Bad effects of pruning.

should be operated upon, especially in the case of such as are reduced to mere shells and are not likely to derive benefit commensurate with the labour and the cost of materials involved in bracing or filling.

Young, healthy, vigorous growing trees, that have become damaged or diseased, should in the majority of instances be attended to; but in the case of old specimens on which a great amount of labour and money would require to

be expended, several important bearings must be considered before works of repair are taken in hand.

Historic and valuable trees, those occupying prominent positions on a lawn or in a park, town trees where vegetation is scarce, and such as are not too old and fragile may be dealt with within certain bounds; but to doctor all diseased and hollow trees on the most approved principle in such places as Epping Forest or Burnham Beeches would be highly imprudent, whether from the little benefit which in many instances would accrue by so doing, or the great expense involved in such an operation.

At the outset it is well to remember that filling a hollow trunk and bracing a tree are quite different operations, and carried out with totally different ends in view. Filling a hollow stem or pocket with concrete prevents the spread of disease and decay, while bracing is carried out with the sole object in view of preventing large and unwieldy branches from falling and wrecking the tree. Also a tree may, and often does, require bracing and not filling, so that the one operation must on no

account be looked upon as a substitute for the other. Hollow trees will often flourish for years, for a decayed interior may be surrounded by healthy living wood ; but a broken branch will, to a greater or less extent, mar the beauty of a tree.

It should be understood that a tree does not cease to grow when it arrives at maturity, for, as long as it is alive, annual layers of wood are developed by the cambium. When, however, maturity is passed, deterioration of the timber takes place, when it usually assumes first a reddish-yellow colour, and finally becomes "foxy" or deep reddish brown. Then comes wasting away of the wood ; the stem gradually becomes hollow as age advances, the process of decomposition being hastened by minute parasitic fungi and insects, which greatly aid in bringing about rot or decay.

The filling must be adapted to circumstances, and to deal with the entire trunk of a hollow tree is in most cases quite out of the question, both from the point of utility and expense. Short-lived trees, as the alder, birch, and poplar, or such as are liable to sudden attacks of

PARTIALLY REPAIRED TREE.

FILLING A HOLLOW TRUNK.

[*To face page 14.*

insect and fungoid pests, and those that are unfavourably situated in mining and chemical areas, should be scantily dealt with ; but the practical woodman will see at a glance which trees are best worthy of his attention and treatment.

Probably the simplest, certainly the cheapest, method of dealing with diseased and hollow trunks is to clean out thoroughly all dead and decaying matter, the interior being scraped and swept with a rough brush, so that the loose rotting wood and bark are removed. When quite dry, the interior of the trunk should be painted with one or, preferably, two coats of creosote or carbolineum, and filled up with a composition of one part of Portland cement to three of clean gravel and sand, the surface coating at the orifice containing the largest quantity of cement. A coat of coal-tar on top of the dry creosote goes far in making the concrete adhere to the wood.

When a fairly healthy tree is being operated upon, and when the bark is likely to grow over the exposed surface, the concrete should only be brought up on a level with the under

side of the living bark ; in other words, the cambium should be left free for expansion. Sometimes brickbats broken small are used instead of gravel, but for various reasons concrete is preferable. The concrete surface may be prevented from cracking by applying annually a coat of paint, which, for appearance sake, may be of a similar colour to that of the bark of the tree. This can best be undertaken when the sap is not running too freely, as then the cambium is less active and less liable to injury.

In the case of a large tree in which the trunk is quite hollow, usually with a basal and top opening, the amount of cement required to fill the cavity precludes the possibility of such being employed, on the score of economy ; but where the hollow only extends for a comparatively short distance upwards and inwards the composition is to be recommended. When a large amount of material is required to fill a hollow stem, clean bricks broken to about the size of a golf ball may be used, but they must be packed firmly, and the surface, wherever it is exposed to the weather, glazed over with

cement in order to effectually shut out dampness. Asphalt has of late years been employed in the filling of hollow stems, and on account of its elasticity and lasting properties is to be recommended.

Sometimes the interior of a large, hollow tree stem is strengthened by cross-beams of timber, any holes which extend to the outside being carefully covered with sheet lead or zinc so as to prevent the ingress of water. A sheet of lead or zinc is, however, only a superficial remedy, and should be dispensed with where filling the cavity is at all practicable. Lead in some cases is preferable to zinc for covering wounds in trees, as it fits into position more readily and is easily fixed. It has, however, the disadvantage of tempting the thief.

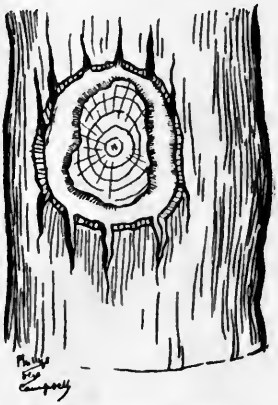
Both for the sake of appearance and for the health of the tree, broken and diseased branches should be attended to with as little delay as possible, the main point being to prevent water lodging in the wound and so setting up disease. This is especially necessary when the branch has been broken close to the main stem or one of the heavy limbs, and when in all likelihood,

if unattended to, disease would be carried direct into the main trunk. Perhaps old elm trees suffer most in this way, owing to the brittle nature of the wood, which causes it to snap readily, and also to the fact that this tree is more apt to be affected by disease and heart-rot than most other species. Not only are the branches readily broken over by the wind, but what is known as branch-shedding often takes place during still, hot weather, and without the slightest warning.

The point at which a branch has been broken over should be made quite smooth, first by aid of a saw, and afterwards by the pruning knife or chisel, care being taken that the bark around the wound is neither injured nor loosened, and that it comes close up to the saw mark. A coat of paint or, preferably, coal-tar may then be applied, both pruning and dressing being carried out during dry weather. A broken branch or tree stem should never be sawn over on the horizontal, but always in a sloping direction, so that water may pass off rapidly. When, from accident or otherwise, the stem of a tree requires to be sawn over,

this should invariably be done just above a healthy limb.

When, as is often the case, a portion of the trunk is carried away by the falling limb, the difficulty of dressing and otherwise attending to the wound is greatly increased. But in all



Wound healing rapidly.

cases smoothness of surface and prevention of ingress of water are the principal points to be observed in the treatment. The best covering for tree wounds is undoubtedly coal-tar or zinc paint thinly applied, under which a callus readily forms. Either may be applied with a brush, and just in sufficient quantity not to run on the adjoining bark during hot weather. This can, however, be obviated by mixing a

small quantity of finely powdered slate or wood ashes with the tar or paint, a composition that is in frequent use for roofing purposes. It is readily applied, and, though quickly hardening on the surface, remains soft and elastic underneath. The heat of the sun will not melt it, while the coldest weather does not cause it to crack or peel off. It is an excellent composition for using on rough and uneven surfaces, and will firmly adhere to the wood.

Another composition that is in frequent use, particularly on the Continent and in America, is prepared as follows :—Take a quart of tar and boil it slowly for four hours, adding four ounces of tallow and one pound of beeswax, stirring frequently until the mixture begins to thicken. Add to this one pound of dry, sifted clay, stirring until quite thick. It is readily applied by means of a knife and completely excludes moisture, does not crack or peel off, and, owing to remaining in a plastic condition, can at any time be pressed by the hand into corners and crevices of the wounded surface. Grafting wax is valuable for covering tree wounds, but is somewhat expensive. For

wounds made when pruning, or where accidentally the bark is stripped from the stem of a tree, the place may be covered with grafting wax, and the wood underneath will remain sound and healthy. The following is the recipe :—Melt in a pot a pound of tallow, double that weight of beeswax, and four pounds of resin, stirring well during the boiling process. For all practical purposes, however, coal-tar or paint, if thinly applied to diseased or wounded timber, is hard to beat.

The treatment of hollow stems without filling the cavity is in certain instances quite permissible, and can be carried out at a comparatively small cost. Broadly speaking, this method consists in cleaning out all decayed and decaying matter, painting the interior with carbolineum or tar, and where possible bracing the trunk from the interior by means of stout cross-bars of wood, and covering surface holes with lead, zinc, or sheet copper. When a tree trunk is hollow from top to bottom this method is to be recommended, and stout struts placed within the cavity at various of the weaker points will go far in preserving many

an aged specimen. When the cavity in a hollow stem is so large that a person can enter it, the work of either filling with a suitable composition or supporting with wooden struts is greatly simplified.

Covering holes in the trunk with wood instead of lead or zinc has had promising results in a number of old elm trees in a London park that were operated upon fully a quarter of a century ago. The wood used was oak and Spanish chestnut, formed to exactly fit the openings, and which, after being treated with creosote, not only prevented the ingress of water, but, in most cases, did not prevent a callus forming over the blocks. Severe and well-directed pruning of the head will often, too, when the tree is not too far advanced in decay, rally and prolong the life of an oak, an ash, or a chestnut. Many examples of the good effects of carefully reducing the upper branches of old and weather-worn trees could be pointed out.

Recent experiments have proved the value of a mixture of sawdust and asphalt for filling cavities. It is particularly valuable in cases

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WOUND HEALING OVER FILLING OF WOOD.

where concrete is too rigid and unyielding, such as in dealing with trunks and branches that are apt to be swayed about in stormy weather. The materials are dry sawdust, that of oak, chestnut, and beech being preferable, and solid asphalt, derived from the refining of petroleum, and which is at present in use for filling the interstices of street pavements in various parts of the Metropolis.

For filling cavities in heavy swaying branches, one part of asphalt to four of clean, dry sawdust will form a mixture that is non-rigid and yields with the motion of the branch in which it is inserted. In dealing with the trunk, which is more rigid and less affected in stormy weather, a larger quantity of sawdust should be used. The filling is made by stirring dry sawdust into boiling asphalt until the desired consistency is reached, and before the composition has cooled it should be inserted in the previously prepared cavity. As in cement filling, the preparation of cavities to be filled with sawdust and asphalt should be carefully attended to, the decayed wood and all soft and rotten material being removed, and

the interior surface rendered sterile by an application of carbolineum or kerosene. For wound dressings gas-tar and liquid asphalt are also to be recommended, this combination forming a more continuous and elastic covering than is the case when tar or paint alone is used.

Where the cavity is small and, as is often the case, filled with water and decayed and decaying vegetable matter, the following course is recommended. When only a few inches deep, the water can usually be got rid of by mopping it out with a sponge attached to a convenient handle ; but when the hole is too deep for this method the water may be got rid of by tapping, that is, by boring a hole with an auger through the trunk to the bottom of the hole. A half-inch auger will suffice, and the correct spot to bore can usually be ascertained by measuring the depth of the hole. After the water has been removed the cavity must be thoroughly cleared of all decaying tissue and accumulated vegetable matter, and in order to do so effectually it may sometimes be necessary to enlarge the opening so that a suitable tool may be inserted.

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WOUND HEALING OVER CONCRETE FILLING.

When the cavity has become quite dry—a matter of considerable importance—it should be treated with creosote or carbolineum and afterwards filled with concrete in the proportion of one part of cement to four of clean gravel. Ram the concrete firm, so that the cavity is perfectly filled, and finish off at the orifice with pure cement, and in such a way that the cambium may be induced to form a growth over the edge of the filling.

A cheap but temporary method of dealing with small hollows and cavities in fruit and other trees is to fill these with a mixture of clay and cow-dung in the proportion of two of the former to one of the latter. Knead well, and apply when of the consistency of putty, cleaning and disinfecting the hollows before filling.

Regarding tools in the treatment of certain cavities, much difficulty is often experienced in removing the dead wood, disinfecting the interior, and filling with a suitable composition. Various tools must be used for the purpose, and occasionally the aperture will require to be widened in order that the work may be

carried out in a satisfactory manner. The pruning chisel, gouge, mallet, and saws of several shapes and sizes are most useful in cleaning out a hollow trunk; but the exigencies of each case will point out the most successful means of dealing with difficulties and the tools to be employed.

Of late years, some good work has been done by the London County Council towards the preservation of old and remarkable trees in their Metropolitan parks, and the accompanying illustration shows a giant and well-known beech on Hampstead Heath that has recently been strengthened and its span of life greatly extended by careful removal of all decayed wood and filling the cavity with concrete.

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BEECH TREES ON HAMPSTEAD HEATH.

CHAPTER III

SUPPORTING HEAVY AND DISEASED BRANCHES

A LIMB requires to be braced or strengthened when from its weight and shape it is likely to get wrenched from the main stem during stormy weather, when the weight of the minor branches and foliage is too great for the strength of the limb, when the wood of the tree is unusually brittle, when trunk or limb is decayed, and when, from accident, the tree has become one-sided and lost its natural appearance.

Forked trees often require staying; so do such as have suddenly become exposed to storms to which they have hitherto been unaccustomed. But probably, in the matter of bracing and strengthening, the most important of all trees are those in our public

parks and such as are contiguous to or overshadow dwelling-houses. Park trees should receive special attention in the way of making sure that limbs are secure and not likely to cause injury to visitors; while, in the case of heavy branches hanging over dwelling-houses, these should be carefully and periodically examined, and made secure whenever such is found necessary, any doubt as to whether a limb is insecure and dangerous being given in favour of bracing or reducing the weight by pruning.

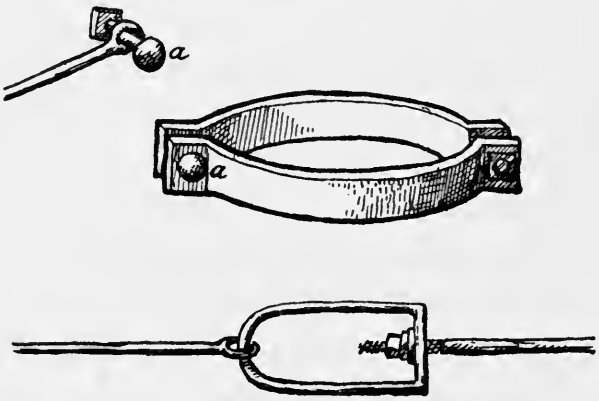
Unwieldy and heavy limbs are most commonly to be found on isolated trees, or such as have had plenty of room for the perfect development of stem and branch. As the loss of one or more of the larger branches often mars the ornamental appearance of a specimen tree, every reasonable means should be employed to prevent such an accident, as by reducing the weight of the branch by a judicious system of pruning, or giving support to such as are heavy and diseased by means of wires, chains, or light iron bands and connecting rods; but in all cases the object should be to

unite the branches in such a way that they may offer the greatest amount of resistance to storms, and at the same time be neither conspicuous nor clumsy in appearance owing to the operation.

There is usually little difficulty in finding a suitable support for a weak limb, for, even if there is no main stem, stout branches on opposite sides of the tree act as capital levers and balance each other. When, however, several branches on the same tree require supporting, the best way is to make the connecting rods radiate from a central ring. This not only does away with any chance of friction by the rods passing over each other, but is more efficient and a considerable saving in the amount of bracing required.

Chains, though often used, probably owing to their being readily obtainable and cheap, are for various reasons to be avoided, the flat iron band lined with leather or rubber being preferable, more readily adjusted, and less likely to cut into the bark and wood. The bands, which can be made by any blacksmith,

are usually $2\frac{1}{2}$ inches wide, and of the shape of the branch to be encircled, each being in two parts for ease in fixing and to allow of slackening at any future time should necessity demand. The band is made of a larger size



Iron band and connecting rod.

than the branch to be encircled, so as to allow of the insertion of a leather or rubber collar between it and the wood, the purpose of the packing being to prevent undue friction and chafing of the bark during movement of the tree.

The bands, whether placed around two opposite branches or the main stem and a branch, are connected together by a light iron

rod, which, according to the strain, may be from one-half to three-quarters of an inch in diameter. This rod, like the bands, is divided into two parts, which are connected by a swivel and screw for convenience in loosening or tightening.

Great care is necessary in choosing the point at which a band should be placed, and equally so as to which branches or branch and stem should be joined together, so that the greatest resistance may be obtained, and in order that the one may act as a support to the other. The shape of the tree and disposition of the stem and branches can alone be a guide in this matter. When compared with a chain, the advantages of this method of supporting heavy branches are principally ease of fixing, greater rigidity, less friction, adaptability for loosening or tightening as may be required, and better results.

It is usually trees with heavy ramifying branches that require attention in the matter of bracing, and, equally so, such as are short-stemmed and spreading of head.

With open-headed trees such as the oak,

elm, Lebanon cedar, and evergreen oak, this method of bracing and connecting the heavier limbs is to be recommended as being readily carried out and most efficient. In the case of young or quickly growing trees—which, however, it is rarely necessary to operate upon—the bands passing around the limbs should be made considerably larger than the size of the branch to be encircled. A padding of disused leather belting or rubber will fill up the intervening space and leave room for the expansion of the branch. Accurate measurements as to the size and shape of the limb to be operated upon must be taken, and the girdling hoops made accordingly. In order to do so, the best way is to ascend the tree, and, after arranging as to the points where bracing is to take place, encircle each branch with a strip of hoop iron, which will not only give the size but shape of the particular limb—a most important point where neatness is studied and after-chafing of the bark and wood is to be avoided.

In the case of old trees, or such as are not likely to increase greatly in size, the bands

A NEGLECTED AND BADLY BRACED TREE.

PROPER METHOD OF BRACING A TREE.

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need not be much larger than the actual size of the branches to which they are to be affixed ; but, where the tree is young and vigorous, room for expansion should be provided. Fixing the bands and connecting rods is readily accomplished, either by the use of ladders or climbing the trunk and slinging the portions into position by means of ropes ; but the exigencies of each case will point out the best means of carrying out the work, as also the height at which the supports can most effectively be placed. When damaged or diseased branches are being dealt with, great care is necessary to ensure that the bands are placed in such positions that the greatest leverage against wind is afforded, and so as to minimise the risk of the branch being broken across at the weakened point during stormy weather.

No hard and fast rules can be laid down as to the size of bands and connecting rods that should be used, this greatly depending on the weight of the branch to be supported and the leverage to be obtained. The bands and connecting rods used on the " Wilberforce " and

"Pitt" oaks, already referred to, in both of which cases the far-spreading branches were unusually heavy and diseased, were of the following dimensions: bands, 2½ to 3 inches wide and ¼ inch thick; connecting rods, ½ inch to ¾ inch diameter. Incidentally it may be mentioned that 360 lbs. weight of iron were used in bracing the "Wilberforce" oak.

Both trees were perfectly hollow-stemmed, with heavy upright and horizontally spreading branches; and, as the writer had the work of repairs carried out twenty-six years ago, the results speak for themselves. A thorough examination of these oaks was made during the summer of 1915, when it was found that the iron bands and connecting rods were in perfect condition; and though the trees are standing in a somewhat exposed situation, overlooking the vale of Keston, not a branch has been broken, nor have the bands done injury either to the bark or timber, and that after having been in use for a little over a quarter of a century, thus clearly demonstrating that properly made and adjusted bands and connecting rods are preferable to any

other contrivance for supporting heavy and diseased branches.

In the accompanying illustrations, the appearance of the "Wilberforce" oak previous to girdling and other attentions is shown, and also after repairs had been carried out. In this case the hollow stem was not filled with concrete, the aperture being considered too large for such a course of treatment. Strong braces were placed inside the hollow trunk, and after a thorough cleaning and disinfecting of the interior the apertures were neatly covered with sheet lead.

Large, heavy, and unwieldy branches of the oak, elm, and other trees are frequently torn completely off at the main stem during stormy weather, and the same occurs with forked trees by the tearing apart of a portion of the bifurcated trunk. Huge wounds that are difficult to treat in a satisfactory manner are sometimes caused by the riving apart of the heavy limbs of a forked tree, and where this is the case it may be better to cut down the tree altogether than to patch up the damaged stem. Where, however, treatment of the

fractured portion is decided upon, the splintered wood should be carefully chopped away, the surface smoothed with an adze, and a thick coating of tar or paint applied. In dressing the wound, great care is necessary to ensure that the healthy bark comes up to the edge of the wood.

Frequently, where the main trunk divides into two or more portions near ground level, it will be found that a split or crack has been brought about by the swaying of the divided stems. In such cases the split between the stems should be carefully cleaned out, treated with an antiseptic, and filled with asphalt. The limbs should then be braced together by means of a band and connecting rod, and as the asphalt becomes set the brace may be tightened up as found necessary.

Rarely is it found necessary to place a band around the stem of a tree to prevent splitting. Where, however, appearances point to the likelihood of such taking place, as in the case of forked trees, especially when the stem divides abruptly into two or three heavy limbs, it is a wise precaution to encircle the bole with a

wide band of iron, which should be placed at such a height that the greatest possible resistance to splitting of the stem is brought about. Such bands are usually of a size proportionate to the strain of the stem to which they are to act as support. A band of leather or rubber between the iron and bark, to allow for expansion of the stem, is necessary.

Occasionally we have to deal with injury caused by the friction of two branches, whether on the same or different trees. The best plan in such cases is to cut off or shorten beyond the point of injury one of the branches, but where such is not admissible they may be kept apart by carefully arranged braces. Wounds caused by the rubbing of two branches are sometimes deep-seated and require cautious treatment in the matter of pruning, and the application of a suitable solution to keep out the damp.

Supporting tree branches by chains, though frequently carried out in the past, is not to be recommended, for the simple reason that, however carefully they may be adjusted, friction and chafing of the bark and wood are sooner or

later bound to come about. Connecting the flat iron bands, already referred to, by means of chains or strand wire is, however, not to be objected to, nor is the method attended with such ill effects as in the case when the chain or wire is placed in direct contact with the branch, for, even with the most careful adjusting and packing, the uneven surface of a chain, with its saw-like action during stormy weather, soon renders the belting useless for the purpose intended, and both bark and wood suffer in consequence.

Many examples of the injurious effects of chaining tree limbs together could be pointed out, though, fortunately, the practice is not now so common as was the case in the past. Occasionally we see holes bored through the live branch or trunk in order to fix the binding rod or chain—a most reprehensible practice that, fortunately, has few supporters amongst those who have even a cursory knowledge of trees and their growth. It is, however, generally admitted that there are several disadvantages connected with bracing trees with iron rods that pass through holes bored in the

FORKED STEMS BRACED BY A CHAIN.

ELM TREE IN TOWER OF LONDON BRACED AND FILLED.

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trunk or branch. However carefully this operation may be performed, there are grave risks from insect and fungoid attacks in holes that have been made in living wood, as the friction caused by the movement of the tree renders healing of the wound quite problematical. Then the movement of an embedded iron rod is not only apt to cause friction with the wood, but the strain must often be in an opposite direction to what was intended, this increasing with the diameter of the stem or branch. In an instance that came under my notice lately, the rod had not only become quite bent, but had cut deeply into the timber at the inner or tree side of the borings. Again, boring a hole through the centre of a branch, be it live or dead, must considerably weaken it at that point, and render it more liable to snap across in windy weather than if encircled by a properly adjusted band. The rigidity, too, of an iron rod that extends in one piece from stem to branch must cause a certain amount of friction at the points where it enters and emerges from the wood.

Granted that boring a hole through the

trunk or branch and thus affixing the supporting rod is simpler and cheaper than when an iron band is used, yet, whether from a physiological point of view or on the score of utility, the encircling band and loose connecting rod have many advantages.

Some writers who recommend fastening unsafe limbs by passing the connecting rod through the living wood, or by chains, object to the iron band around the stem as likely to cut into and injure the bark and cambium. But such an objection is hardly tenable when the work of bracing has been carried out as directed in the present chapter, nor is it supported by actual results that have been obtained from trees so treated. The band must be made in such a way, and of such a size, that there will be no possibility of the iron wearing its way into the wood and thus weakening the branch and defeating the end in view. By making the band, as directed, in two parts with a loosening attachment, it can be adjusted at will—tightened or slackened as required—while the leather or rubber band quite does away with chafing or injury to the

bark. The band and connecting rod should be placed as high as practicable, this following from the law of the lever and the fulcrum.

Another untidy, slipshod, and most objectionable method of staying a tree is by using wire as a band around the trunk. This certainly has the virtue of cheapness, but in so far as efficiency is concerned, and especially in the case of old trees, is to be deprecated. In the accompanying illustration this method of tying heavy limbs together is well represented, in which it will be seen that, in order to prevent friction of the bark, pieces of wood about six inches long and two inches wide are inserted lengthways between the wire and the stem. With the motion of the tree these pieces of wood are apt to slip unless nailed to the tree—a somewhat dangerous proceeding. But the whole system of staying can only be considered as temporary and weak, and unless in the case of small trees should never be adopted.

Supporting heavy and diseased branches by means of wooden props is only admissible where there is no main trunk or upright strong

limb to which they can be attached by means of bands and connecting rods. Branches that approach to near ground level, and to which the public or farm stock have no access, may be supported by means of wooden uprights, but at best these look clumsy and out of place. Where, however, it is the only means of supporting unwieldy limbs, the work should be carried out in as tidy and efficient a manner as possible. The size of prop to be used will depend on the weight of the branch requiring support, but, generally speaking, a pole of from 8 to 10 inches diameter at top will be found most suitable for this purpose. Yew, oak, or any timber of well-known lasting qualities, with little sapwood, and thoroughly seasoned, makes the most efficient supports, and, for appearance sake, and so as to be in keeping with their surroundings, the bark should be left intact.

Forked props are sometimes used as supports, but in the majority of cases the crutch should be dispensed with and a slight hollow grooved out at the upper end of the pole, into which the branch will fit. Packing material may be

placed between the branch and supporting post, and the two made fast by a band of hoop iron. Sometimes a cross-piece of wood about 12 inches long is nailed on top of the post, this serving as a rest for the branch to be supported. At what distance from the main stem the supporting prop should be placed in contact with the branch can only be decided on the ground and after a careful examination, but in all cases the greatest weight of branch should be between the trunk and its support.

Leather and rubber have been found by far the most suitable mediums for placing between the iron band and stem or branch that is to be supported, not only on account of their lasting properties, but because of smoothness of surface and the ease with which they may be adjusted. Old leather or disused machinery-bands are cheap and serve the purpose well, and when being prepared for use should be cut a little wider than the iron band with which they are to be used. Sometimes felt or other like substances have been used, but they are not to be compared, for efficiency or lasting properties, with either leather or rubber.

Periodical examinations of all bands and connecting rods should be made, oftenest in the case of young and fast-growing trees, to see that loosening of the collars is not required, and that the packing has not become shifted by the swaying to and fro of the trunk and branches during stormy weather. A coat of paint or tar, given every fourth year, will go far in preserving the iron bands. In no case must the band be allowed to get embedded in the trunk or branch around which it is placed, and in order to obviate such an evil the band, as before stated, must be divided into two parts for ease in loosening, should such be required.

It occasionally happens, as in the famous beech tree at Knole Park, and oaks at Welbeck, that owing to age and decay the whole tree is in danger of falling, and in such cases the only remedy is to apply props, or wire the main stem to adjoining trees where these are within reach. In such cases great care must be exercised that the stays, whether of wood or wire, be placed in such positions that the stability of the tree is ensured.

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PROPPING A DECAYED TREE.
KING JOHN'S OAK, KNOLE PARK, SEVENOAKS.

Three double-strand galvanised wires attached to the trunk at three-fourths its height, and made fast to adjoining trees in opposite directions, will go far in preserving an old and unsafe tree from falling to pieces. Should no trees be convenient to which the wires can be attached, stout posts placed in the ground will serve the purpose, but they are dangerous to pedestrians, and should only be used in places from which the public are excluded. Wooden props are to be preferred in positions to which the public have access, and often, by careful manipulation, the stability of an old and crumbling tree is ensured by this method of treatment.

In the accompanying illustration the brace has been placed much too low or near the fork, the consequence being that as a stay or support it is practically valueless. It should have been placed at least three times its present height from the fork ; also the connecting wires are much too light to withstand the movements of the heavy limbs to which they are attached. But altogether the system adopted is bad in the extreme, and points out how use-

less it is to entrust the work of tree-staying to other than those who have practical knowledge of the operation. The driving of wooden wedges between the wire girdle and bark is, to say the least of it, a very primitive and unsatisfactory proceeding.

In the repairing and strengthening of tree limbs it should consistently be borne in mind that any girdle or band that either partially or wholly constricts the growth of a branch defeats its own object by preventing the uninterrupted flow of sap and strengthening of the limb. With care in forming the band and a proper method of adjusting, there is no reason, however, why the desired object of strengthening a stem or branch may not be attained. But, on the other hand, a badly formed, narrow band, too tightly applied and without the requisite packing, may in a short space of time be productive of the most unsatisfactory results, particularly in the case of young and fast-growing trees. The main point is to fix the bands in such a way that friction with the bark is avoided and the flow of sap uninterrupted. Unfortunately, in the past

this has not in all cases been carefully carried out, with the result that the bands, owing to their being too small, gradually became embedded in the wood and, by injuring the cambium and preventing the flow of sap, defeated the object for which they were intended.

With ornamental trees it is sometimes found necessary to sling or suspend branches that overhang paths or come in too close contact with the lawn or turf, and particularly when the removal or shortening of such branches is undesirable. Unless the branches are heavy and far-spreading, when the iron band and connecting rod already referred to may be found necessary, a sling or collar of thin sheet iron or other metal lined with rubber or leather may be placed around the branch and connected by stout fencing wire to the main stem higher up the tree. Two lengths of strand wire twisted together, which admit of being tightened at pleasure, are most suitable for the purpose. The size and strength of band will vary with the thickness and weight of branch to be supported, but should in all cases be

sufficiently wide not only to afford the necessary support, but to prevent friction with the bark or wood.

For a branch, say, up to six inches in diameter, the band may be three or four inches wide. It should be made collar-shape, with a quarter-inch circular hole at each end, to which, when bent around the branch, the supporting wire from the main stem is attached. When a branch is small and readily supported or tied back to the desired distance, a band of stout leather or roofing-sheet may be substituted for the metal, the double wire being used as before for connecting it with the main stem or one of the larger branches. This is a simple and inexpensive method of dealing with obtruding branches, and in practice has been found to answer well. By a careful manipulation neither the band nor wire need appear obtrusive.

That the preservation of trees by bracing is receiving more attention than in the past is evident from the number of old elms and oaks in the London district that have been operated upon of late years. On one estate about fifty

trees have been treated in this way during the past two years, and in several gardens known to the writer individual trees that required staying have been treated in an up-to-date manner.

CHAPTER IV

INJURED BARK ON ROOT AND STEM

Loosened and injured bark is most frequently brought about by careless felling and haulage, injury from a passing cart or wheelbarrow, and in not a few instances may be directly caused by frost, snow, lightning, fires, insect and fungoid attacks, or growing the trees in unfavourable surroundings as to soil and situation. Ground game, as also rats and mice, do much damage to the bark of young trees.

From whatever cause arising, early attention to injured bark is to be recommended, and that not only on the score of health, but appearance of the tree as well. All loose bark should therefore be carefully cut away, and the wood, when perfectly dry, coated with coal-tar. In removing the injured portions, cut well back into the living bark, so as to ensure rapid and uniform healing, remembering that bark that

has become detached from the wood will never again unite, but simply form a breeding ground for injurious insects. Should the wood from which the bark has been accidentally removed be injured in any way, the pruning chisel may be requisitioned and all the damaged portions carefully cut away and the surface smoothed over before the tar is applied.

On old commons and open grounds, where at one time cattle-grazing was allowed, many of the trees suffer from wounds and disease that were originally contracted through bark injuries; and even nowadays, in our public parks, the cricket-bat and knife of the visitor have much to answer for in the matter of maimed and injured trees. Trees in olden times, too, suffered much from being used as fencing and gate-posts, the permanent injuries from which, in the driving of nails, bolts, hinges, and wire attachments, are plainly visible at the present time. Little can now be done for such, though, where fungus has attacked the injured bark and trunk, a careful system of pruning and dressing with tar will lend a helping hand in arresting decay.

Maltreated trees in parks and commons frequently become the prey of several boring beetles, especially the goat and wood leopard moths and the elm bark beetle. The two former attack both injured and sound timber, and in the case of the goat moth in particular branches become so weakened by the tunnelling that they snap across in stormy weather. Careful examination will alone reveal the presence of the goat and wood leopard moths, as the mouth of the entrance hole or tunnel is frequently filled with plastic sawdust. By clearing out the holes and inserting a small quantity of cyanide of potassium, the pests will quickly be eradicated. Where the elm bark beetle is abundant, the best remedy is to strip off and burn the loose bark, and in the case of badly affected trees to remove these wholesale.

Squirrels, hares, rabbits, voles, and mice frequently attack the bark of trees, both young and old; but, as their depredations are considered in the chapter devoted to "Injuries from Animals and Birds," they need not receive attention here.

Bark-scorching produced by the rays of the

sun is confined to trees with a smooth, thin bark, such as the beech and hornbeam. The ash, sweet chestnut, lime, and sycamore also suffer, though in a less degree. Though bark-scorching may be brought about by suddenly exposing tree stems to light and sunshine, as in the case of severely thinning an exposed plantation, or by removing heavy, shade-bearing branches from isolated trees, yet examples are not wanting, on almost every common and in our parks, of trees being injured by direct action of the sun. The effects produced are curious, the first indications being a light, creamy colour of the affected bark through exposure of the cambium ; then strips or patches become fissured and fall off, and in severe cases the wood becomes diseased and rotten.

To trees growing in isolated positions, hot sunshine striking on the bark during early spring, after a wet and cold winter, is most injurious.

Root injury is a frequent cause of trouble, especially on lawn and standard trees, and may be the result of a knock or injury from a

passing cart, roller, or mowing machine. Such injuries soon become tenanted by the honey fungus (*Agaricus melleus*), which often is found in masses at the base of the affected tree or contiguous to large roots. Accompanying the fungus will generally be found long, black, stringy growths, which spread with great rapidity beneath the bark and on dead stumps and in the adjoining soil. They quickly spread from root to root, the health of the tree is affected, and, if left untouched, they will ultimately cause its death. The honey fungus, which, by the way, is edible, attacks the roots of many species of coniferous and other trees.

Another root fungus is the well-known *Fomes annosus*, which specially preys on the roots of the Scotch pine and silver fir, as also the hazel, birch, and lime. Where possible, all traces of these fungi should be removed and the affected parts treated with carbolineum.

When fungus has permeated the roots, little can be done to save the tree ; but with superficial injuries, remedies, if applied in time, are generally followed by good and lasting results. Roots which run near the surface are most

often liable to injuries, and are, fortunately, most readily attended to. The soil should be removed from around the decaying root, the diseased portion with the loose bark cut back to the healthy wood, and the whole painted, first with an antiseptic, and finally, when quite dry, with coal-tar. Should the tree have suffered much in health from the injuries, branch pruning and enriching the soil amongst the roots will often be found beneficial.

As well as the above, there are many other causes that bring about the loss of bark and an unhealthy condition or the death of a tree. Some of these are natural decay, an escape of gas and poisoning of the soil around the roots, and piling earth around the stem. The latter is a fruitful cause of decay and death, and if the soil is of sufficient depth the trees may succumb in from eighteen months to two years. Where railways are being constructed or large quantities of soil dealt with in the carrying out of ground work improvements, injury to trees by piling it around the stems most commonly takes place.

Where depositing soil on the roots and

around the stem cannot well be avoided, and the instances are few, "dishing" should be practised. This consists in forming a saucer-like receptacle with the soil around the tree trunk, and at a distance of, say, six feet from the stem. Sometimes a retaining wall of old bricks is built around the stem, but in most cases it will be found sufficient to gradually slope the soil from the trunk backwards, and thus allow of the proper aeration of the ground. Trees, the roots of which have been covered with soil to such a depth that an unhealthy condition is brought about, quickly fall a prey to root fungus and the attacks of injurious insects. As showing the evil effects of placing earth at too great a depth around a tree stem, the accompanying illustration of an elm trunk is reproduced. First the bark became loose and fell off in patches, then diseased wood appeared, and finally the dread fungus *Stereum* brought about the death of the tree.

Stagnant moisture is usually readily removed, while natural decay and a stag-headed condition may in some cases be at least temporarily dealt with by timely and

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"DISHING" A TREE STEM.

judicious pruning and by substituting fresh soil for the spent material amongst the tree roots.

From the above it will be seen that, if taken in time, bark and other tree wounds are by no means difficult to deal with, nor is the work entailed by so doing of a costly description ; and, this being the case, there is no reason why specimens that are of particular value in an ornamental or useful sense, or such as are of historic interest or with interesting associations, should not, when accident befalls them, receive prompt and careful attention in order to ward off disease and death.

In connection with loosened bark several important points should be borne in mind. Injured or loose bark can never again attach itself to the trunk, though we have known several instances in which, in the hope of inducing it to grow again, those who were unacquainted with or ignored the laws which govern plant life have carefully nailed it to the trunk. Such a method of treatment is not only a waste of time and attended with the opposite results to what were intended, but the

decaying bark and injured wood attract myriads of insects and fungi, which hasten disease and often cause the death of the tree. Instead, therefore, of refastening the injured and loosened bark to the stem, it should be carefully removed quite back to the living bark, bearing in mind that, even where a piece of bark is adhering to the stem, without a living shoot it cannot survive.

With old and diseased trees it is well to occasionally examine the bark by tapping, as frequently large patches, particularly near ground level, become separated from the trunk. Such dead portions should be entirely removed till contact with the living bark is established, and the underlying wood painted with two coats of tar. Bark-shedding is most often associated with trees that have become unhealthy through soil or atmospheric conditions.

Snow, especially when in a moist condition and the fall heavy, does considerable damage to trees and shrubs by breaking the tops and branches and injuring the bark. Amongst ornamental trees the evergreen oak and Lebanon

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ELM KILLED BY PILING EARTH ON ROOTS, AND ATTACKED BY STEREUM PURPUREUM.

cedar, owing to their flat, horizontally arranged branches, fare worst, though other species are by no means exempt from injury. The brittle nature of the wood of the Lebanon cedar also renders it particularly liable to damage, while the tufted and thickly foliaged branches of the evergreen oak collect the snow, and suffer greatly in consequence. The only remedy is to shake the snow from the branches by means of a wooden rake or long, forked pole—work that can only be extended to important trees in park or avenue. Amongst forest trees the Scotch pine and spruce suffer most, whilst brittle-wooded hardwoods, such as the willow and beech, are apt to get damaged during a snow-storm.

Both ice and hail are injurious to trees, the former weighing down and breaking the branches, especially when frost quickly succeeds rain, while hail damages the osier crop and sometimes young coppice plantations.

Fires do serious damage to plantations all over the country. Pine plantations growing on sandy or gravelly soil and carpeted with heather are most liable to be destroyed, though

single trees dotted over a gorse-covered common are usually killed when a conflagration of the undergrowth takes place. Probably sparks emitted by railway engines are responsible for most of the fires in rural districts, and particularly where railway lines traverse plantations that are mainly composed of coniferous trees. Negligence, and fires due to incendiarism, come next in number.

Scorched trees, particularly when the bark peels off, rarely recover their wonted vigour; and even when the damage done by fire appears at the time insufficient to necessitate the removal of the crop, the rapid attack of insect pests soon makes the felling of the injured trees a necessity. There is little doubt that the heat generated in the soil over which a fire has raged has as much to answer for in the damage to the health of the trees as the scorching of the stems by the flames. On several estates known to the writer, where large areas of heath-covered, gravelly land are covered with the Scotch pine, fires are of almost annual occurrence. This is mainly attributable to the carelessness of visitors, who, in one case

at least, on account of the pleasant district and extensive scenery, flock to the place in large numbers during the summer holidays. The origin of the fires is usually near pathways or camping grounds—a clue to the perpetrators.

Prevention of fires is out of the question, though over wide areas of plantation much may be accomplished by cutting clearances or rides, say, about sixty feet wide, and keeping these free of brushwood, heather, or long grass. Such clearances help to intercept the fire and keep it in bounds.

CHAPTER V

PRUNING DISEASED TREES

During forty years' practical experience in the management of woods and plantations, the writer has often expressed the opinion that rarely is sufficient attention given to the pruning of diseased and injured trees. What is meant is this, that in the case of stagheaded trees, resulting from age or unsuitable soil and surroundings, or such as have met with accident through falling branches, lightning, insect and fungoid attacks, or other causes, a judicious system of pruning back dead and dying branches to the living wood has a decidedly beneficial effect in throwing new vigour into, and prolonging the life of, a tree.

Good examples of what has been done in this particular way may be seen in a few isolated instances in various parts of the

country, but the system is by no means so often adopted as the results would warrant. The old Spanish chestnut trees in Greenwich Park, the oaks at Richmond, or the elms in Kensington Gardens and Regent's Park are excellent object-lessons of how diseased and dangerous trees may be rejuvenated for a time at least by a well-ordered system of pruning. Sixteen years ago, the Spanish chestnuts in Greenwich Park were in a deplorable and dangerous condition, there being hardly a tree without quantities of dead and dying wood, mainly owing to the age of the trees, and want of attention when accident befel them, as also the light, gravelly soil on which they are growing.

When it is stated that nearly four hundred cartloads of dead wood were removed from these trees during two consecutive winters, some idea of the appearance they presented before pruning operations were commenced may be imagined. As might be expected, many, indeed the majority, of these trees were infested by the wood leopard moth (*Zeuzera æsculi*), the ravages of this boring insect having

extended not only to the dead but living wood as well. The goat moth (*Cossus ligniperda*) was likewise abundant, but its depredations were mainly confined to the old elm trees, several of which were literally riddled by the tunnels of this formidable insect, and in some instances the damaged trees snapped across during stormy weather. In removing the rotten wood from these trees, particular care was taken that all dead and dying branches were cut well back to, or rather beyond, the living wood, this being a most important point where the production of young shoots is desirable. At the point where each branch was cut off, the wound was made smooth with a pruning knife, and painted with tar to prevent ingress of damp and aid in rapid healing. During the following spring, the trees so operated upon sent out an abundance of young shoots which quickly obliterated all trace of pruning, and in a few years the well-rounded heads of healthy foliage showed how the trees responded to the removal of dead and dying wood.

In the case of the elms in Kensington

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GOOD EFFECTS OF PRUNING A DISEASED TREE.

Gardens and Regent's Park, a decided change for the better has been brought about by the careful pollarding of all dangerous and unhealthy trees, though in both cases there was at the time a public outcry at the dastardly treatment to which the trees were being subjected. Time, however, has proved that the Park authorities were justified in their action. By the Broad Walk in Regent's Park, about one hundred elm trees that years ago had been damaged by lightning and storms and become the prey of numerous injurious insects were attended to in the matter of pruning and pollarding. Usually, injuries to tree stems cover but a small portion of the surface, but in the case of such as have been struck by lightning, the damage in many instances extends for twenty to thirty feet along the trunk and for various widths up to nearly two feet, not only the bark being ripped off, but the wood in not a few cases receiving injuries as well. In this particular instance, many of the elms had become positively dangerous to the public owing to the injuries they had received, and it was found necessary, in order to prevent

accident and rejuvenate the trees, to shorten back the larger upper and side branches. The treatment has been attended by the most beneficial results, as will be observed by the present healthy appearance and well-furnished heads that the trees have formed.

The elm responds quickly to pruning or pollarding, and even though the stem may be partially hollow, its wonderful recuperative powers after being beheaded are perhaps greater than those of any other tree, and, as will be seen from the accompanying illustration, aerial roots are sometimes sent out from the damaged stem. Occasionally these extend downwards till they become rooted in the soil. In the case of the Regent's Park elms referred to, the majority had been struck by lightning many years ago, and owing to non-attention some were partially hollow, others with deep, wide scars where the lightning had passed along the trunks and main branches, while all were more or less infested by the goat moth and elm bark beetle, as also several species of fungus. Rotten wood and bark were removed and all scars thoroughly cleaned and painted

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AERIAL ROOTS ON A DISEASED ELM TREE.

with tar at the same time that the pollarding took place. Of course young trees respond more quickly to pruning than do old specimens, but there are few instances, even in hollow and diseased elms and oaks, in which at least temporary benefit will not result from judicious removal of dead and injured wood.

Special attention has been directed to the treatment of trees in some of the Royal parks, as they furnish excellent object-lessons of the good results that are to be obtained by pruning, while the grounds, being pleasantly and centrally situated, are visited by large numbers of interested persons.

There can be no doubt that the removal of dead and dying timber has a most beneficial effect on the health of a tree, be it young or old. Trees, generally speaking, are wonderfully recuperative and quickly respond to attention in the matter of repairs to injuries and judicious and well-directed pruning.

The latter in particular causes a tree, if at all healthy, to send out fresh growths near the points at which branches were removed, and in the case of the elm often all over the stem.

The only disadvantage, if such it can be termed, is the reduction in height owing to the removal of the upper branches; but this is more than compensated for by the improvement both in health and appearance of the trees that have been operated upon.

In pollarding a tree, care is necessary to preserve the natural outline; in fact, the finished tree should be as nearly as possible a miniature of the original.

Occasionally the damage done by the breaking of a branch is serious alike to the health of the tree and quality of timber. The wound may have become entirely healed over, but the decay of old standing have made steady progress and eaten far down into the trunk of the tree. This is by no means an uncommon occurrence with trees that have been neglected when a branch got broken over close to the stem, and shows how necessary it is that all injuries should be promptly attended to in the matter of pruning and painting; indeed, the old saying, "A stitch in time saves nine," applies forcibly to the treatment of damaged trees.

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ELM TREE INJURED BY LIGHTNING.

The tearing away of a branch close to the main stem, such as during stormy weather, if not attended to, will frequently be found to have set up incipient decay at the point of breakage, which, aided by damp and fungus attacks, will extend for a considerable distance into the stem and greatly injure the quality of the timber. Although not claiming that pruning will remove such a defect, yet, by a proper course of treatment, the progress of the evil may be arrested. Usually, where a branch has been broken over close to the trunk, the snag or remaining portion dies back, forming a cavity in the tree with the rotting branch in the centre, and surrounded by the growing wood. In such a case the diseased and rotting wood, often permeated by fungus, must be carefully removed, the edge of the cavity made smooth with a pruning knife, and, after the interior has become quite dry, the whole should be painted with coal-tar. Filling the cavity as described in Chapter II. is to be recommended.

In pruning or removing a living branch, it should be borne in mind that a clean cut with

a sharp pruning knife following the line of the tree stem is conducive alike to quick healing and non-injury to the adjoining wood. Large branches must necessarily be removed with a saw, but the wound at point of amputation should be neatly smoothed over with an adze or pruning knife before being painted with tar. In order to prevent splitting the wood and tearing the bark when removing heavy limbs, a saw-cut should be made on the under side of the branch at the point where amputation is to take place.

The management of trees in the Metropolitan area leaves much to be desired; indeed, in certain cases it would almost appear as if the owners courted disaster by the treatment to which their trees have been subjected. This not only refers to trees growing in streets and thoroughfares, but to those in private gardens and grounds.

When branches are removed, the work, unless in a few instances, is carried out in a rather slipshod and barbarous manner, by splitting the wood and tearing the bark, while little attention is usually paid to painting or

tarring the wound to ward off damp or insect attacks.

Branches frequently get wrenched from the tree stem during stormy weather, but rarely do we find that such wounds have been attended to in the matter of pruning or painting. Injuries to root and bark and attacks of injurious insects and fungus seem beyond the notice of most people, while filling or covering a cavity so as to keep out the damp and prevent rot is rarely thought of.

In the treatment of wounds that are caused by the removal of branches, the main point is to prevent the wood cracking or becoming diseased before it gets callused over or covered by the cambium. With large surfaces and in the case of certain trees this is by no means easily accomplished. Some trees bleed more freely and for a longer period than others, and the constant exudation causes the wounded surface to become diseased if not periodically attended to in the matter of cleaning and dressing. Both the elm and sycamore, though the cambium spreads rapidly, are, owing to this exudation, apt to become diseased at the point

where the branch was removed. In such cases the wound, until it is quite hidden by the new growth, should be examined periodically—say, every third year—and the exposed surface cleaned and the paint or tar renewed.

With the horse-chestnut and some other trees the wounded surface is apt to crack and requires careful attention in filling and tarring. When the wound is small—say, under six inches in diameter—healing is, in the case of healthy trees, rapid and continuous ; but where a large surface of wood has been exposed in pruning, eight or ten years may elapse before it becomes covered by the new wood. In such cases, rot and disease can only be averted by periodical treatment in the way of cleaning and painting the exposed surface. But, indeed, in all cases, tree wounds will amply repay, by quick and satisfactory healing, the labour entailed by a triennial examination and doctoring.

CHAPTER VI

INJURIOUS INFLUENCES FROM SOIL OR ATMOSPHERE

Diseases due to an unsuitable condition of soil and situation are most noticeable in stagheaded trees and in such as are subjected to atmospheric impurities or to excessive drought or dampness.

Stagheaded trees, or such as have the top branches dead and dying, are common enough in the case of old specimens or such as are growing under unfavourable conditions as to the amount of dampness in the soil. But many causes may bring about the death of the crown of a tree, such as lowering the water level by the making of a lake or by excessive drainage, exposure of the trees to chemical or other fumes, and, in the case of old park trees, by exhaustion of the soil and want of nourish-

ment, these in most cases being merely the first stage in the gradual death of the tree, or senile decay. Old oaks are particularly liable to become stagheaded, a term that has been given from the fact that the upper branches become gradually denuded of leaves and twigs and assume the appearance of stag-horns.

But it is not only the oak that suffers in this way, for beech woods often become stag-headed before the trees have arrived at maturity. The elm, when subjected to too great an amount of dampness in the soil, often loses its crown ; and the poplar, willow, and alder, which favour damp situations, fall a prey to stagheadedness in light, warm soils. Stagheaded oaks and other broad-leaved trees usually remain alive for many years before succumbing, and much may be done not only to arrest decay but to generally improve the appearance of the trees by judicious pruning.

The old Spanish chestnuts in Greenwich Park and oaks at Richmond before referred to are examples of trees that have become stagheaded and unhealthy owing to their age. In each case, however, much good has resulted from

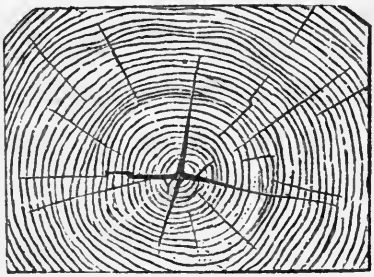
removing the dead wood, which, if left, becomes a breeding ground for various boring insects. When removing these dead branches it is advisable to cut well back into the living wood, which will induce the tree, if not too far exhausted, to throw out fresh twigs and foliage.

Where larch and other poles become "pumped" or hollow, it is a sure sign that they are growing in unsuitable soil, and the only remedy is to clear the crop and plant the ground with trees that are more likely to succeed. The larch usually becomes hollow-stemmed when growing in gravelly soils resting on clay, while red-rot is most prevalent with several species of pine and the silver fir when they have been planted in soil that is surcharged with moisture. The growth of lichens on trees may also be accounted for by excessive moisture in the soil.

Young trees of the Spanish chestnut and oak suffer from the effects of frost in the bark becoming rent and exposing the timber to view. It is caused by rapid shrinkage of the bark and sapwood during frosty weather, and is most

common in newly thinned oak, chestnut, and elm woods.

Premature seed-bearing may usually be put down to an unhealthy condition of the tree, which excites an abnormal tendency towards the reproduction of the particular species. Speaking generally, seed-bearing in any con-

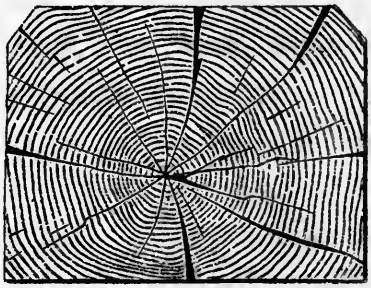


Heart-shake.

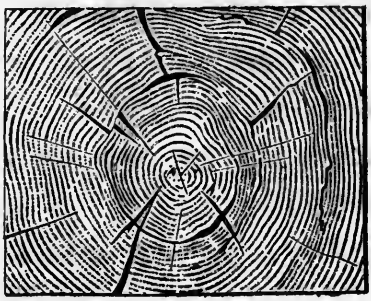
siderable quantity before the tree has attained to its normal height is a sure sign that the tree will not attain to a valuable size. With the larch, early seed-bearing is always a sign of decay and heart-rot, and the same applies to the Scotch and other species of pine.

Heart-shake is prevalent in almost every kind of timber, and may best be described as clefts or splits that follow the medullary rays from the centre outwards. Star-shake radiates

from the centre towards the outside, the clefts being widest at the sapwood. Cup-shake renders much of the timber of the trees so affected valueless for constructive purposes. In



Star-shake.



Cup-shake.

soft-wooded trees like the poplar and Spanish chestnut, cup-shake is brought about during stormy weather, as the stem, in bending backwards and forwards to the blast, causes the concentric layers of wood by alternate compression

and extension to separate. Both star- and cup-shake occur in perfectly sound and healthy trees, and their presence cannot be detected till the tree is felled. Usually cup-shake is local, and on sandy soil on the Woburn estate, in Bedfordshire, the Spanish chestnut trees over certain defined areas were badly affected, and the timber rendered quite useless for constructive purposes. The timber of the Scotch and other species of pines, particularly when attacked by fungus, is apt to suffer from star- or cup-shake.

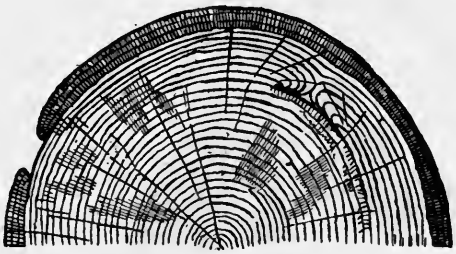
Twisted fibre is common in the sweet or Spanish chestnut, oak, sycamore, horse-chestnut, and other trees. The twist usually goes from left to right, and renders the timber of trees that are so affected comparatively worthless for converting.

Rind galls are surface wounds that form blemishes in the timber, which becomes disunited from the older wood.

Atmospheric impurities are frequently the direct cause of the death of trees. The injury is most often due to sulphurous acid contained in smoke, the emanations of smelting and chemical works, coal mines, factories, or town

buildings. Evergreens are more sensitive to an impure atmosphere than deciduous trees, the first sign being a sickly yellow look, followed by discoloration of the leaves and death of the upper branches.

In the case of sulphuric acid, the leaves of hard-wooded trees assume a mottled appearance,



Rind gall.

the spots gradually increasing till the whole tissue of the leaf becomes poisoned. Gradually the tree turns unhealthy, with much dead and dying wood, and finally dies out altogether. The only remedy is removal of the cause, though planting coniferous trees such as the Austrian and Corsican pine, instead of hard-wooded species, in the vicinity of coal mines and chemical works is to be recommended.

Smoke from electric and other chimneys does much damage to trees and shrubs growing

in their vicinity. Two instances of such have been brought to our notice of late in the Metropolis, in both of which trees that a few years ago were sound and healthy have been killed by being subjected to the emanations from recently constructed smoke-shafts in the neighbourhood. In one case fully twenty trees, principally elm and horse-chestnut, gradually showed signs of distress in the scantily produced yellowish foliage, followed a year afterwards by many dead and dying branches ; and in the third season the trees had become so unhealthy and disfigured that their removal was imperative. In another instance with which we had directly to deal, some healthy, rapid-growing elms and catalpas were killed by the smoke from an electric shaft. Probably, however, the most deadly fumes to plant life in London are those given off from the gold-refining works at the Royal Mint.

When trees have become unhealthy owing to adverse atmospheric conditions, it is surprising how quickly they become tenanted with injurious insect life. The elm is soon attacked by the bark beetle and goat moth,

while the ash and poplar suffer equally from canker and insect pests. At a later stage fungus puts in an appearance, and the tree that three years before was sound and healthy is reduced to a crumbling ruin. The unfortunate part is, that little or nothing can be done to stay the evil, the removal of the cause being, in most cases, quite out of the question, while after-treatment of affected trees is worse than useless.

Planting only suitable trees in such situations has been recommended, but, with a wide experience in this matter, we have come to the conclusion that no tree is for long capable of withstanding such smoke and fumes, particularly when brought in close contact with the evil. The elder probably withstands chemical fumes better than any other tree, and has been largely planted in Newcastle-on-Tyne on that account.

When the air is still, smoke from tall shafts, by getting spread over a wide area, does less damage to trees than when it is carried for a lengthened period of time in the same direction by the action of the wind. Last spring,

the young leaves of several healthy elm and other trees situated about half a mile from the chimney of an electric producing plant were completely blackened in one night by the fumes being carried in that particular direction by the wind. The foliage never recovered, but crumpled up and fell off, though later in the season it was replaced by a second crop of leaves. This, if often repeated, is distinctly injurious to the health of the trees, and points to the fact that these should not be planted within range of such fumes, and particularly in the direction from which the prevailing winds of the district may be expected to carry the smoke.

Lightning causes damage to trees, principally isolated specimens, but, comparatively speaking, the amount of injury done is trivial and cannot be prevented. The oak, Lombardy poplar, and elm suffer most, and particularly when grown in the open park, by the field-side, in the avenue or hedgerow. It is a strange fact that trees in certain parts of a park or grounds are frequently struck by lightning, while others of a similar kind and size at no

great distance away are quite exempt. In several stations in and around London trees have frequently been injured, while in other parts of the same grounds similar species have remained for years untouched. Usually the damage done to trees by lightning is trivial, only a strip of bark some two or three inches wide from the point where the fluid struck the stem down to ground level being destroyed. This injury, however, if not attended to in the matter of pruning and dressing, may have serious results. It is a simple matter to assist nature in the healing process by careful treatment in the way of pruning and applying a coat of tar as soon as possible after the tree has been injured.

Constricted bark, occasioning a hidebound condition of trees, is brought about either through the roots becoming too feeble to carry out their proper functions, or by exposing hitherto-sheltered trees to cold winds. The bark becomes hard or indurated, loses its elastic properties, and the sap vessels get constricted and their proper functions suspended. Under these conditions the bark of the chestnut and

oak becomes split longitudinally ; that of the beech, owing to smoothness of surface, stretches horizontally ; while in the case of the plane, sycamore, acacia, and other trees the outer bark peels off. Scoring the trunk and main branches is to be recommended, and, by leaving the inner layer of bark uninjured, considerable latitude may be taken with the rough external coating.

Scorching from the heat of a fire causes the bark of a tree to peel off, and the injured wood becomes tenanted by fungus and boring insects.

It is a well-known fact that an increase or diminution of water supply will have an immediate effect on the health of trees that are growing within the specified area.

Not long ago, the writer was asked to report on a large number of trees that had suddenly become unhealthy, some having died out altogether. The cause was not difficult to trace, for adjoining the plantation, which was principally composed of beech trees of sixty years' growth, growing on a gravelly bottom, a lake had been formed, which completely

changed the condition of the soil through excessive drainage.

The beech, above all trees, is extremely susceptible to such a change, the first indications of injury being noticeable in the scant, yellowish foliage, which is quickly followed by gradual dying back of the upper branches, and, in severe cases, by the total death of the affected tree. Unfortunately, nothing can be done in such a case, the only remedy being to cut down the crop and replant with more suitable species, such as the birch and cluster pine. But cases of such a kind are far from uncommon, and the drainage of buildings adjoining timber land has often been the direct cause of an unhealthy condition of the trees. Excessive dampness of the soil can readily be counteracted by drainage.

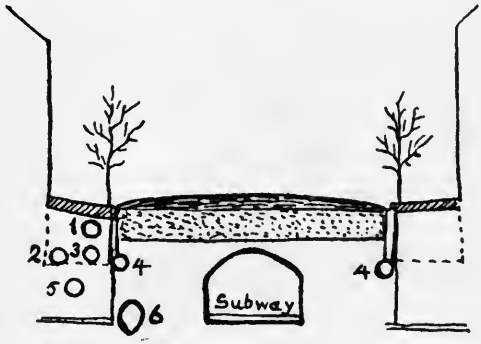
Surface water that has become contaminated with refuse from chemical or oil works finding its way to the roots of trees, often acts most injuriously. Several instances have been brought to my notice in which portions of healthy plantations have been killed outright where the roots of the trees came in contact

with the drainage of certain chemical works; and in another case an unhealthy condition of the Scotch and Austrian pines was brought about by sewage that had been allowed to pass over the surface of the ground from neighbouring dwellings.

Near the main entrance to the Tower of London and Billingsgate Fish Market, considerable difficulty was experienced in getting the plane trees established, though the question of suitable soil and the choice of sturdy, well-rooted specimens had received due attention. At last it was found that the drip from the fish carts was the cause of the evil, a remedy for which was quickly found. But such cases are by no means uncommon in towns, and, in some of the gardens along the Thames Embankment and at Westminster, trees and shrubs have suffered from the effects of treating the roads with asphalt and similar compositions.

Not a few of the sudden and mysterious deaths of healthy town trees can be directly attributed to an escape of gas. Of all trees, those growing in our greater centres of industry

undoubtedly fare worst, for not only are they subjected above ground to dust and fumes, but beneath the surface the roots come in contact with gas and water mains, drains, sewers, electric and telegraph ways. Of all these, undoubtedly the gas main is most to be dreaded,



Section of a town street.

1. Water main.
2. Telegraph.
3. Electric.
4. Surface water.
5. Gas.
6. Sewers.

for with the smallest escape of gas, too small to be detected by the company, the largest and healthiest trees quickly succumb to its poisonous effects. Even the escape of a few feet per day is sufficient to poison the soil, especially where such is clayey or where the roadway is paved, for then the pent-up gas, with no chance of escape, quickly permeates

the soil and hastens the death of trees within its area.

The effect of gas on trees is somewhat curious: sometimes they die off quickly, apparently without the slightest warning; and at other times the leaves look sear and thin, the bark peels off, and gradually the branches give way, until finally the whole tree succumbs. This may be accounted for by the quality of soil and amount of gas leakage, for when all the roots are in the affected area the death of the tree is rapid.

Many instances have lately occurred in the Metropolitan area in which trees have either been killed outright, or become so unhealthy that their removal was imperative, by an escape of gas, notable examples being at Holloway, Hampstead, and the Garden City at Letchworth.

Shedding of the bark, especially in town trees, is an early indication that most probably the tree so affected is being gradually poisoned by an escape of gas. Small patches, at first near ground level, fall off, but as time wears on large breadths become affected, the tree

wears a decidedly unhealthy, sparsely foliaged appearance, and finally dies off. As if to hasten the decay of an injured tree, the elm bark beetle and the goat moth quickly appear on the scene and tunnel the already diseased wood and bark, thus aiding the poisonous gas in its work of destruction. In some instances, where the cause was discovered at an early period, good results have been brought about by remedying the evil ; but usually the location of a leakage is by no means easy, as in loose soil the escaping gas will follow the pipe for several yards.

Soil that once has become tainted with escaping gas rarely regains its original sweetness, and is unsuitable for the healthy development of plant life ; and so it is that, when once affected, few trees permanently recover. Fresh lime thoroughly incorporated with the soil is perhaps the best remedy for gas-infested areas.

From this it will be inferred that an escape of gas near the roots of a tree has a most injurious effect and is difficult to contend with, for, once the soil is poisoned, a return to normal condition is rarely brought about.

First the foliage of the affected tree looks thin and sickly, then the bark peels off, then comes the attack of insects and fungi, and finally what was once a strong, healthy tree succumbs to the poisonous effects of escaping gas.

The accompanying section of a town street will give some idea of the difficulties trees have to encounter when planted in urban and suburban districts.

CHAPTER VII

FUNGUS GROWTH ON TREES

Trees are not only liable to suffer from the attacks of insects, but often receive irreparable damage from the growth of various cryptogamous plants, such as fungi, lichens, and mosses. Some fungi attack living wood, some dead, and some both ; and, while the majority are found growing on the stem, others attack the twigs, leaves, or roots. They are of all sizes, from the almost microscopical to the beefsteak fungus, which often exceeds a couple of feet in diameter. Some are jelly-like in consistency, others leathery or almost woody in texture ; and while certain kinds spring up and disappear in a few days, others remain intact on the tree stem for several years. In shape, too, they vary considerably, from the curious Jew's-ear fungus, which greatly resembles the

human organ, to the giant puff-ball, that sometimes measures four feet in circumference. Then the cup-shaped and parasol fungi are appropriately named, while the flat, shelf-like arrangement of a species that frequents the oak and elm has interested many a casual observer. Excepting perhaps green, they are of almost all colours from dull brown to the brightest crimson, while beautifully spotted and mottled kinds are not uncommon. Some are valuable as food, others being utilised in the making of tinder and razor strops.

Healthy trees growing under normal conditions are little affected by fungi, whereas such as are predisposed to infection, by unsuitable soil, excessive drought or dampness, injury by accident or otherwise—in fact, a weakened condition however brought about—are, of course, far more liable to attacks. Though certain species of fungi only attack dead and decomposing wood, and are, therefore, the consequence and not the cause of disease, there are others, fortunately fewer in number, that attack healthy living trees and are the direct cause of disease and death. The

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DISEASED ELM AFFECTED BY FUNGUS.

prevention and extermination of fungus pests is by no means an easy matter, but by keeping the woods free from dead and dying branches and trees, and immediate attention to outbreaks of the malady, much good may be brought about.

In the following notes, only the most serious cases are dealt with, or, in other words, such fungi referred to as are commonly met with and cause most damage to our woodland trees.

Polyporus squamosus attacks the elm and other hard-wooded trees, and rapidly accelerates their decay. It is of large size and leathery consistency, with a yellow, scaly top, and is usually present where a branch has been broken off, or other damage caused to the trunk or limb. Removing the fungus and attending to the injury by cleaning and tarring will usually set matters right.

The oak, when diseased, becomes the prey of quite a number of fungi, one of the most formidable and injurious being known as *Polyporus dryadeus*. This fungus is often 18 inches in diameter, and when fully de-

veloped turns to a rusty brown colour, and is usually furrowed of surface. Another wound parasite is *Polyporus sulphureus*, which is yellowish in colour and often two feet across. It produces red-rot in oak, and is a common occupant of old orchards. Cleaning away all diseased wood and painting with creosote is recommended.

The red-rot fungus (*Fomes annosus* or *Trametes radiciperda*) attacks the roots of several species of pine, particularly the Scotch, Corsican, and Weymouth, as also the spruce and silver fir. It is probably the most destructive of the family, attacking living roots and spreading rapidly from tree to tree. The trees, when affected, quickly turn sickly and die, the wood turning spongy and of a brownish colour, with distinct black spots. The only remedy is to take out affected trees and burn them root and branch, replanting the ground with beech or elm. Though one of the most destructive fungi in coniferous woodlands, yet its attacks are by no means confined to such ; it is also found on the roots of several hard-wooded species, such as the filbert, hazel, birch, and

beech. Quite recently a nut plantation in Kent suffered severely from the attacks of this fungus, whole lines of trees being killed out before the cause was detected. It spreads quickly underground from tree to tree, and unless eradicated, which is easily done by uprooting affected trees and carefully destroying the mycelium, much damage may be the result.

The white-rot fungus (*Fomes igniarius*) is usually found on hard-wooded trees, and takes possession of wounds that may have been occasioned by the accidental breaking of a branch or stem injury. Oak trees suffer most from the attacks of this fungus, which is often a foot across, and of a brownish colour. It is named *igniarius* on account of the inner surface being used as tinder, when prepared with saltpetre, especially in the old days of flint and steel. By removing the fungus and attending to the wound in the matter of cleaning away all dead and dying matter, and coating with tar, much good will be brought about.

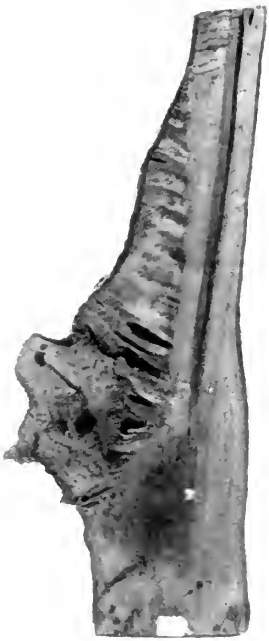
One of the commonest fungi on old stumps is *Agaricus* or *Armillaria melleus*, the tree

root rot. It has no particular host, being found alike on coniferous and hard-wooded trees, and on both root and stem. Known as the honey fungus and edible, this toadstool is about three inches in diameter, and of a yellowish-brown or rusty colour, with greyish scales near the top. It spreads with great rapidity both in the soil and between the bark and wood of the affected tree. The only remedy is digging out and destroying the fungus, and, in the case of healthy young trees, collecting and burning the mycelium.

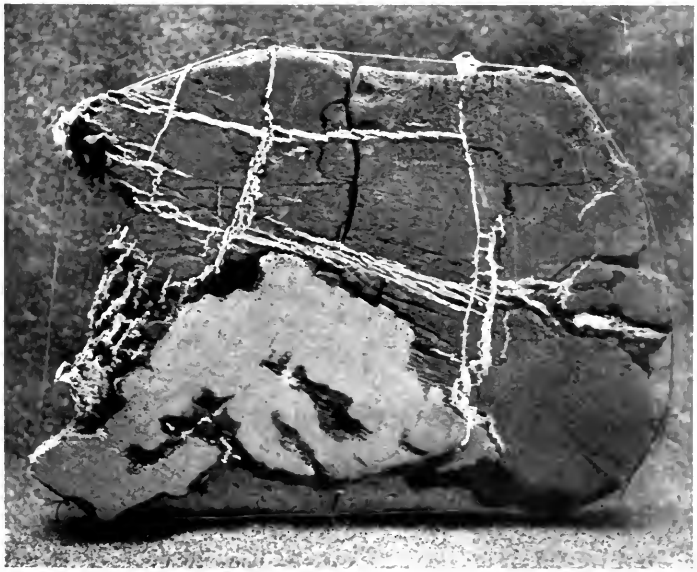
Dry rot is caused by attacks of that far too common fungus *Merulius lacrymans*, more usually known by the name of the "dry-rot fungus." It is abundant everywhere, both in living and dead wood, the latter principally. The use of immature timber in buildings, aided by imperfect ventilation, is the main cause of attack. Carbolic acid applied to the attacked timber is to be recommended, and painting with carbolineum produces excellent results.

Fungi do not, as a rule, thrive on dusty, dry wood, but the present species is an ex-

TIMBER INJURED BY MISTLETOE.



TIMBER INJURED BY MISTLETOE.



DRY ROT FUNGUS (*Merulius lacrymans*).

ception, as, when once established, it produces, in respirations, water in sufficient quantity to render the infected timber either moist or sodden. The decay in mining timber, especially in coal-pits, is due in a great measure to dry rot, and in Westminster Hall the oak beams were found to be in many instances attacked by this fungus in conjunction with one of the boring beetles. In the Yorkshire and Midland coal-pits, treating the timber with creosote, carbolineum, or other antiseptics is regularly resorted to.

The canker of hard-wooded trees is brought about by one of the *Nectria* (*N. ditissima*), and is very common in every part of the country, affecting the oak, beech, ash, sycamore, and fruit trees generally. Ash perhaps suffers most, the timber turning black and being quite unfitted for structural purposes. It is strictly parasitical, growing on wounded portions of the stem and branch, and spreads with great rapidity, attacking trees of all ages. We have known the trees in a plantation of ash to be quite destroyed by this canker, which attacks most freely those growing on wet, sour land ;

and this should be a warning to planters to avoid such soil. For remedies and preventive measures see "Canker, or Canker Fungus," page 169.

Coniferous trees suffer quite as much as hard-wooded trees from the attacks of various fungi. The larch canker or blister fungus (*Peziza Willkommii*) has proved by far the most destructive of any in our woodlands ; in fact, the amount of damage done by this wound parasite may be considered as little short of a national calamity. Whole plantations in every part of the country, Ireland now included, have suffered severely from its attacks, and in many instances the trees have been cut down and others planted in their stead.

Usually the attacks take place in young plantations, say, between the age of ten and fifteen years ; but it must be remembered that at no period of its existence is the larch immune, though in old trees, probably on account of their harder bark and wood, there is less liability to attack. Soil would not appear to count, for trees growing on chalk, gravel, deep loam, and vegetable

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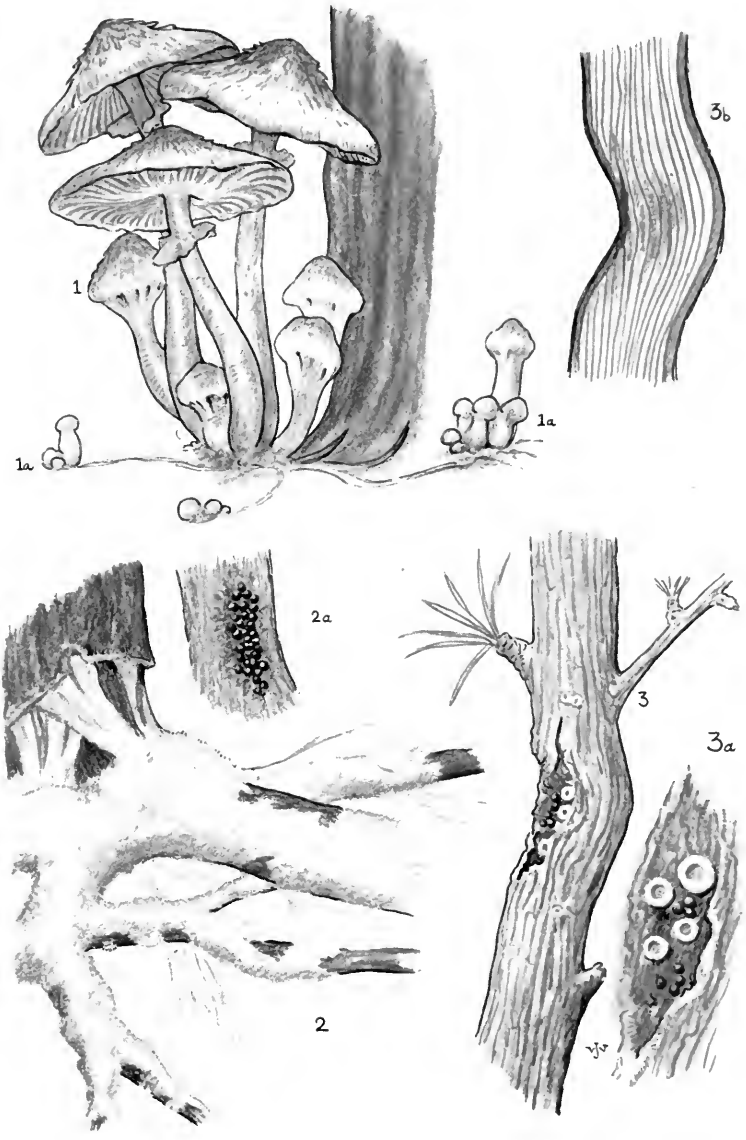

1, 1*a*. HONEY FUNGUS (*Agaricus melleus*).
2, 2*a*. WHITE ROOT ROT FUNGUS.
3, 3*a*, 3*b*. LARCH CANKER.

mould have all become a prey to this fell disease. Low-lying, badly drained land is certainly the home of the disease, and especially where mists and frosts prevail; but the moist climate of Britain generally favours the spread of the fungus. At one time, some dozen years ago, it was thought that larch growing on the Irish peat-bogs were exempt from the disease, but unfortunately this is not the case.

The first indication of the larch disease is a gouty swelling on the stem or branch, which quickly splits open and causes the resin to flow copiously, giving a dark, glistening appearance to the affected parts. Gradually the wound becomes larger, pieces of dry, hardened bark peel off, and the whole has a dark, scurfy appearance. The fungus in itself is small and cup-shaped, in colour bright yellow, with a greyish margin, and is widely propagated by means of the abundantly produced spores.

Though we have known instances in which cankerous trees have partially recovered, yet it is generally accepted that, once a tree has fallen a prey to this insidious disease, it rarely

attains its wonted vigour, and in any case the timber is almost valueless in a commercial sense. Remedies are almost out of the question in the case of a plantation of larch becoming affected, but isolated specimens may be successfully treated by carefully cutting out the diseased portions of wood and bark and painting with tar. In order to partially avoid the disease, plantations of pure larch should not be established, mixing with hard-wooded species such as the beech and sycamore being recommended. Cleanliness of a plantation goes far in warding off the larch canker, and for this reason all dead and diseased trunks and branches should be removed or burnt, and the trees individually given a fair amount of room, crowded plantations in low-lying, close situations being first attacked.

The spruce in southern England is occasionally infested with *Peziza resinaria*, the attacks being similar to those of the larch canker. It is a wound parasite, and mainly induced by frost cracks, excessive or bad pruning, or by leaving injured branches or snags on trees.

The leaf-shedding fungus or pine-leaf scurf

(*Lophodermium pinastri*) is a well-known and widely distributed species, and is usually found on the Scotch and Austrian pines. The leaves, when attacked, wither suddenly and fall off, the fungus being most prevalent after unusually dry weather, or in early spring succeeded by a frosty winter. It occurs both as a saprophyte on dead pine leaves and as a parasite on the living foliage. We have been most successful in combating the attacks and preventing the spread of the pest by spraying the affected parts with "Bordeaux mixture." Young trees under ten years of age are most commonly attacked, and when this occurs in the nursery borders, the plants should be rooted out and burned. On several Scottish and English estates thousands of Scotch pines have been killed out by the attacks of the leaf-shedding fungus.

Next to the larch canker, one of the most destructive diseases of forest trees is caused by attacks of the bladder-rust or cluster-cup (*Peridermium piniacicola*). It is a wound fungus and attacks almost every species of pine, the Scotch in particular, and especially when the

trees are growing on light, poor soils. Young trees up to, say, twenty years old are most commonly attacked by this fungus, which appears like blisters, emitting bright reddish-coloured spores. Rooting up and burning all affected trees is the best remedy.

Daldinia concentrica.—As will be seen from the illustration, this rare and curious fungus occurs on the ash in closely arranged groups of half a dozen or more, and is usually found where decay is present in the timber. It is of a dark brown colour, solid and smooth of surface, flatly globular in shape, and two inches in diameter. When cut across, the curious concentric zones in the tissue of the fungus resemble those of the graining in timber. It remains intact on the tree for several years. Like several other tree fungi, it occurs in London, and specimens may be seen on ash trees by the canal bank in Regent's Park. Removing the fungus and dressing with carbolineum has so far been attended with good results.

Coral Spot Disease (*Nectria cinnabarina*).—This, one of the commonest of fungi, may

CORAL SPOT FUNGUS.

FUNGUS INJURING ASH TREE.
(*Daldinia concentrica.*)

FOMES SALICINUS ON WILLOW.

be found on almost all hard-wooded trees, though it would appear partial to the sycamore, elm, apple, and pear. It attacks both living and dead wood, and may generally be found on old pea-stakes, faggot-wood, and poles, particularly where such are piled together in a damp and sunless position. Though of small size, it is one of the most conspicuous of the family, being, in the first stage, of a bright coral-red colour, gradually dying off to a rusty brown. The first appearance of attack is betrayed by the sere, drooping leaves, which soon fall off; the bark becomes rough and shrivelled, after which appears the coral fungus, Though not of a deadly nature, it spreads rapidly, and should be kept in check by pruning off and destroying diseased branches, and keeping the ground clear of dead and dying wood.

Sclerotinia.—In the life-history of this fungus there are several distinct stages, that known as *Botrytis* being by far the most injurious to trees, and causing the now well-known and much-dreaded leaf-shedding of certain coniferous trees.

Young trees whilst in the seed-bed or

nursery stage of growth are most commonly attacked, though instances are on record of the foliage on tender shoots of old trees being damaged by this parasitic fungus. Few of our commonly cultivated coniferous trees would appear to come amiss to the attacks of the *Botrytis*, the larch, owing no doubt to the quantity in which it is grown in this country, suffering most. Two-, three-, and four-year-old seedlings are the favourite host of the fungus, and it attacks not only the common and Japanese larch, but Scotch, Austrian, mountain, and other pines, the silver and Douglas firs, common and weeping spruce, as also the deciduous cypress and Wellingtonia. In affected seedlings the first indication of the attack is a sickly appearance of the leaves, followed by contortions of the shoot ; though, curious to state, the lower portion of a stem may only be attacked, as if the infection proceeded direct from the soil. The diseased leaves fall off prematurely, as do also the tips of affected shoots ; and though the attack may not at once kill the tree, repeated onslaughts render young plants worthless for planting out.

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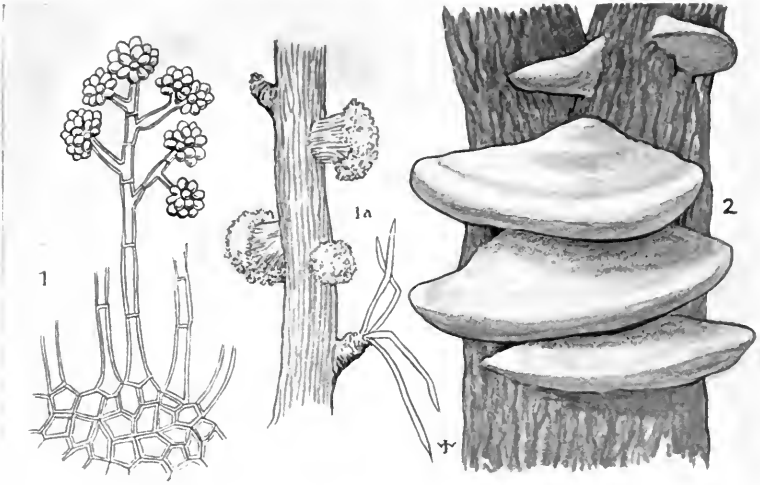

1, 1*a*. LEAF-SHEDDING FUNGUS (SCLEROTINIA). 2. FOMES ON OAK STEM.
3. SYCAMORE LEAF FUNGUS.

As the spores of this fungus have been found to grow freely on weeds and other plants, its rapid distribution is readily accounted for. When the fungus has made its appearance in nursery ground, all fallen twigs and leaves should be carefully collected and burnt. Spraying with the Bordeaux mixture, or a solution of copper sulphate, 4 lbs. to 100 gallons of water, is recommended.

The Sycamore Fungus (*Rhytisma acerinum*).—Attention has lately been directed to the unusual scarcity of the sycamore fungus in certain districts during the past season, but, unfortunately, the disappearance has been far from general throughout the country.

Everyone interested in trees must be familiar with the conspicuous black, pitch-like spots which so mar the appearance of sycamore leaves at all seasons of the year, but particularly towards the autumn. These are due to the above-named fungus, which, appearing as small yellowish spots on the under sides of the leaves towards the end of June, gradually increase in size and intensity of colour until they attain to fully half an inch in diameter

and are inky black, which is well set off by the margin of dirty yellow.

The attacked portion of the leaf becomes wrinkled and much thickened in texture, while all the affected foliage drops off prematurely. After lying on the ground during the winter, the thread-like spores are emitted in vast quantities at the time when the foliage of the sycamore is appearing in May and June. It is, however, not only the sycamore that is attacked by this fungus, for the Norway maple and our native field maple (*Acer campestre*) are equally liable to injury, and have in some instances suffered very severely.

Altogether this fungus is a formidable pest, that is becoming yearly more plentiful and disfiguring the maple and sycamore leaves to a wide extent. Another fungus which infests the leaves of these trees is *Rhytisma punctata*, which may at once be distinguished from the former species by the many small black spots studded thickly together, which combine to form the large conspicuous blotches for which affected trees are remarkable. Both species are sometimes found on the same leaf. As

the attacks of this insect go on from year to year, and as usually almost every leaf is affected and drops off prematurely, the health of the tree is greatly enfeebled, and it thus becomes an easy prey to the still more destructive coral spot fungus (*Nectria cinnabarina*).

Considerable difficulty has been found in keeping this fungus in check. By burning the affected leaves before the spores are liberated in spring, the spread of the fungus is to some extent prevented.

As showing how carefully all diseased leaves and twigs should be destroyed, the following case may be pointed out. A badly infested tree was cut down and removed, but the leaves of the young shoots that were sent up from the old stump during the following season were as badly attacked as those on the original specimen.

The "Witch's broom" of the birch, or "birch balls," is due to the attacks of the parasitic fungus *Taphrina turgida*. It forms twiggy clusters with comparatively small foliage, which usually present a greyish colour on the under sides in particular. As prevention is out of

the question, the only remedy is cutting off the growths, which, however, unless appearing in large numbers, but little affect the health of the trees.

There are many other species of fungus that attack our woodland trees, but those described have caused the greatest amount of damage to our timber trees generally.

Root fungi should be carefully guarded against in the replanting of ground, by the removal of stumps and decayed timber of every description, even chips, pieces of old planks, and fencing-posts having been found to foster the growth of the fungus. Repeatedly have we seen young trees of various kinds die off without any apparent cause, and on examination of the roots have found they had become permeated with fungus which originated on timber that had been left in the ground at time of planting.

The beautiful vivid green colour assumed by oak and pear timber under certain conditions is due to the action of the fungus *Peziza* (*Helotrium*) *æruginosa*. The colouring matter is permanent in the timber, and, as it cannot

be destroyed, wood so affected is much sought after by the makers of fancy furniture. Trees growing in damp, shady positions are most often attacked by the fungus, and we have known timber of the oak, when left in a damp part of the woodland, to assume this colour. Owing to the scarcity and high price of green oak timber, experiments have been undertaken to produce the desirable green colour by artificial means, but without success. The wood is unusually hard, and the beautiful graining of the oak is shown off to great advantage in this green timber. It is remarkably scarce, the finest examples we have seen being grown in Kent and on an estate in northern Ireland.

Blueing in coniferous timbers is due to the fungus *Ceratostoma piliferum.* It is common in Scotch pine wood.

Mosses and Lichens.—In damp and shady situations, and particularly when the trees are not in vigorous growth, both coniferous and hard-wooded species are often attacked by moss or lichen, or both. Though the attacks are rather an indication of unsuitable environment than actual disease, yet, when mosses and lichens

abound, the health of the tree is injured and the affected branches die off gradually. In some cases that have been brought to our notice, large numbers of trees have fallen a prey to their attacks. To combat these attacks, drainage and the admission of light and air should be attended to.

How far does the growth of mosses and lichens affect the health of trees? and on what species, and under what conditions, do they grow most? are questions that are more readily asked than answered. Both parasites prevail more on the west than the east coast, owing no doubt to the greater rainfall, and several species seem to grow alike either on stones or trees. The larch suffers most in the south and south-west of England, and in Devon and some of the adjoining counties the common grey lichen is plentifully distributed on many hard-wooded trees. Probably the fact that neither the moss nor the lichen penetrates deeply, if at all, into the tissue of the wood, will explain why they commit less damage than is generally supposed.

The beard mosses (*Usnea barbata*), so

commonly distributed, are usually found where the atmosphere is constantly damp. In order to get rid of moss and lichen on trees, fresh powdered lime should be sprinkled on these during damp weather; or, better still, scrape off as much of the moss and lichen as possible, and then thoroughly scrub the bark with lime-wash made from fresh lime, so thin as to give a slightly white appearance when dry. Sulphate of iron in the proportion of one pound weight to a gallon of water will also destroy these pests, but care in its application is recommended.

But not only are growing trees affected by fungus, for both converted and unconverted timber, particularly such as is in an unsound or immature condition, quickly falls a prey to the attacks of these decay-inducing organisms.

Wood is largely composed of proteins and starch, the special food of fungus, and unless these are rendered incapable of sustaining the life of parasites, decay is sooner or later bound to come about. As a preventive against both insect and fungus attacks, creosote and carbolineum have been found particularly valuable,

and not only so, but, by shutting up the pores of the wood and displacing air and water, the lifetime of the timber is greatly increased. Other substances, such as corrosive sublimate and copper sulphate, have been used, but nothing, either on account of efficacy or cheapness, can surpass carbolineum or creosote.

In the case of young thinnings of pine plantations, the trees, if used as fencing, will in the case of Scotch pine last about five years, and of larch eight years; whereas, if treated with creosote and fungoid attacks prevented, the lifetime will be extended to nearly treble the period.

Forest trees, under certain conditions, are sometimes damaged by the too pressing attentions of such undergrowth as the woodbine and ivy. The ivy does most damage in young plantations of larch and hardwoods, and, if the growths are not kept in check, the annual woody layers become less and less, and ultimately the tree dies out altogether. This is brought about by the restricted sap ascent, which causes the leaves to turn thin and pale and the annual shoots to gradually lose their vigour, and thus

by a system of constricting the stem and slow strangulation the tree ceases to exist. In a young state, when the tendrils of the ivy are small, little harm may be done to its host, but later on, when the evergreen foliage covers the whole top and branches, the results become serious.

The honeysuckle or woodbine is even more harmful to trees than the ivy, though the shrub is much scarcer, comparatively speaking, in our woods and plantations. By its twining growth the expansion of the bark and ascent of sap are interfered with, the outcome being swollen bulges all along the circuitous route taken by the climber.

The traveller's joy or old man's beard (clematis) occasionally damages and kills out trees by twining around the stems; while in beds of osiers both the wild convolvulus and hop give much trouble by their weight in bending over the slender shoots in coppice and willow brakes.

In the case of woodbine, ivy, and clematis, the only remedy is to remove the offending climbers, which may readily be done by simply

severing the stem at a short distance above ground level; while with the hop and convolvulus total eradication is to be recommended.

Trees growing in sheltered, seaside districts are, perhaps, worse affected by the ivy, and in a case at Penrhyn Castle, in Wales, whole plantations had, at considerable cost, to be cleared of this climber.

The mistletoe is a frequent guest of the apple, lime, poplar, and willow in this country, and on the Continent it is found on the Scotch pine and silver fir. Here, little damage can be laid to the account of this parasitic plant, though the lime and fruit trees suffer from its attacks. On the Continent, however, the timber of both the silver fir and Scotch pine is, in some instances, rendered valueless for constructive purposes owing to persistent attacks of the mistletoe. The roots become embedded in the wood to a depth of sometimes six inches, thus rendering the timber valueless for economic purposes. In the apple and lime trees the part of the branch above the point of attack often dies off. The following illustration shows the damage to the timber of the

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WOOD INJURED BY MISTLETOE.

lime trees at Hampton Court by attacks of the mistletoe, sometimes as many as from a dozen to twenty being present on the same tree. In stormy weather these heavily weighted branches are often broken over.

CHAPTER VIII

INSECT ATTACKS AND THEIR REMEDIES

Amongst the various branches of natural science of which the intelligent woodman should acquire some practical knowledge, there is, perhaps, none to which so few direct their attention as the study of entomology. As showing the importance of insect life in connection with our forest trees, it may be stated that in the case of the oak alone it is reckoned that, in addition to the cockchafer, goat moth, oak-leaf roller moth, and other insect foes, no less than forty kinds of galls attack the tree.

Several species of trees suffer greatly from attacks of insects, whether at the root, stem, or leaf, and at almost every period of their existence. In a book of this kind it is quite out of the question to enumerate the many

insects which in one way or another do damage to our trees, and in the present chapter only such as cause serious inconvenience by their attacks will be dealt with, suggestions for preventive measures and the best methods of combating the attacks being given.

The life-history of an insect must be understood before either preventive or remedial measures can be successfully adopted, the most important facts to ascertain being the stage of growth and season of the year at which the greatest damage is inflicted.

There are four distinct stages in the life of an insect: first, the egg; second, the grub or caterpillar, usually known as the larva stage; third, the pupa or dormant stage; and fourth, the adult stage. It is when the insect is in the second or feeding stage that the greatest damage to trees is brought about, as in the case of the goat and wood leopard moths, though the fully developed insect, as in the pine beetle and weevil, has much to answer for in the destruction of the shoots of several species of coniferous trees. Aphides, such as that on the beech and other trees, have also to be contended

with. The ravages of certain insects can be most effectually dealt with when in the egg stage, others by destruction of the grub or caterpillar, while in the case of boring beetles preventive measures can best be carried out when a large area of trees is infested. How the insect hibernates is a most important point in dealing with its depredations and extermination.

The goat moth (*Cossus ligniperda*) is far more common than is generally supposed, and this may also be said of the wood leopard moth (*Zeuzera æsculi*), both of which attack the elm, poplar, ash, and oak. The goat moth frequents the willow, oak, lime—indeed, most of our hardwood trees—the tunnels made by the larvæ being almost large enough to admit the little finger. The popular name of the moth is derived from the disagreeable smell which the caterpillar emits. It is from 3 to 4 inches long, of a flesh colour, with black head and stripe down the back. The moth is brown, mottled and striped with darker markings, and when fully developed is often nearly 3 inches in spread of wings.

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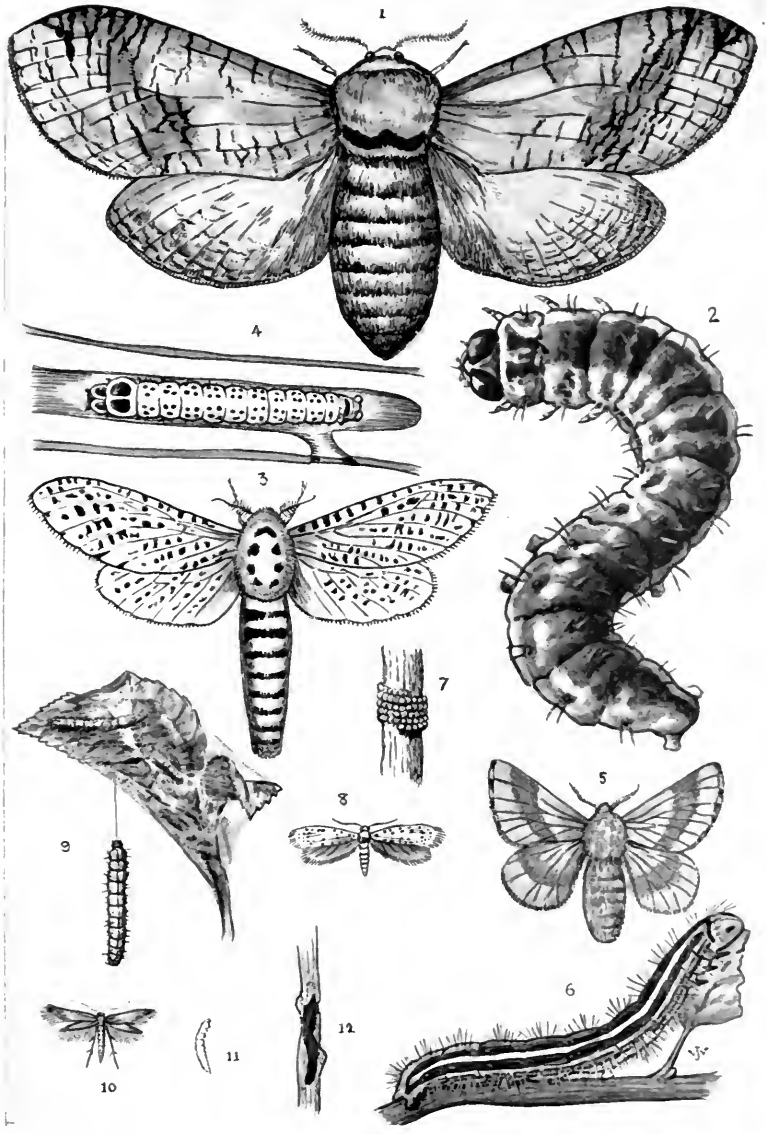

1. GOAT MOTH.
2. CATERPILLAR OF GOAT MOTH, FULLY DEVELOPED.
3. LEOPARD MOTH.
4. CATERPILLAR OF LEOPARD MOTH.
5. LACKEY MOTH.
6. CATERPILLAR OF SAME.
7. LACKEY MOTH EGGS.
8, 9. ERMINE MOTH AND CATERPILLAR.
10, 11, 12. LARCH MINING MOTH AND CATERPILLAR.

The wood leopard moth is smaller than the goat moth, rarely exceeding 2½ inches in spread; the wings are white or grey, with yellowish-brown veins, and there are six dark spots on the thorax; while the caterpillar is yellowish white, dotted with black spots, and having a black head. The larvæ of both moths, which are deposited on the bark of the tree in July or August, tunnel into the wood and do much damage to the timber as well as to the health of the tree. Placing cyanide of potassium in the hole and closing the aperture is the best method of destroying the caterpillar, though we have used gas-tar in a similar way with good results. Carbon bisulphide gives off a gas that is deadly to this and other boring insect pests, and may be used with advantage. Dislodging the caterpillar by means of a bent wire has likewise been successfully carried out. Probably the worst damage by these insects is that occasioned by their attacks on young trees of thorn and pyrus—particularly standards. The caterpillar enters the wood, and in boring upwards weakens the stem, so that it readily snaps across in windy weather. The

burrows are readily discovered by the sawdust at their entrances. The goat moth is met with all over the London area, and the damage to trees by its persistent attacks is sometimes serious. Three-quarters of a century ago, when the grounds of the Royal Botanic Society in Regent's Park were in course of formation, it was found that a number of the elm trees growing around the boundary were more or less affected by the goat moth. Many of the trees were sick, and some so unhealthy as to be beyond recovery. The services of Robert Marnock, the landscape gardener, were called into request, and the following remedy was at once adopted. The hole, or gallery, formed by the grub was cut into by means of a carpenter's round chisel, and filled with a compound of soot, lime, cow and horse manure, formed into a thick paste. The elm bark beetle, which had accompanied the goat moth in its course of destruction, was dealt with by smearing the bark with a thick paste of the same ingredients as that employed to fill up the holes in the stem. Marnock reported, forty years afterwards, that the results of these

two operations "were completely successful, and the wounds in the stems healed with remarkable rapidity." On examining some of these trees during the past season, it was evident that Marnock's treatment had been so far successful, though removing the grub was evidently more efficacious than filling the holes with the mixture he recommended.

Though named *æsculi*, the wood leopard moth is not more partial to the horse-chestnut than to other trees, being found commonly on the elm, oak, and Spanish chestnut. Where a branch of the horse-chestnut has been removed by pruning, the wound is sometimes tunnelled by the larvæ of the wood leopard moth.

The elm tree destroyer (*Scolytus destructor*) is usually abundant in most parts of the country, and is quite a pest to London trees. The beetle is one-fifth of an inch long, stout and cylindrical, and usually confines its attacks to the elm. In June it bores into the inner bark, forming galleries along which the eggs are deposited. Trees infested by this beetle have an appearance as if the bark had been riddled with shot. Fortunately, unhealthy trees are

most frequently attacked, though vigorous young trees are by no means exempt from injury. Cutting down and burning badly affected trees is to be recommended. Less severe cases may be dealt with by an application of tar.

Red spider (*Tetranychus*) is another formidable insect pest that not infrequently attacks the leaves of several species of hard-wooded trees, and is often the cause of death of the ivy, particularly when grown as a ground carpet. The leaves turn a rusty-brown colour, crumple up, and finally fall off, the whole plant dying in consequence. Spraying with soft-soap or paraffin emulsions will prevent the insect from spreading, but its eradication is by no means easy.

Wholesale destruction of the leaves of the spindle tree and other species of euonymus is yearly occasioned by the caterpillar of the small ermine moth, myriads of the caterpillars appearing on the foliage during summer. So rapidly does this insect increase, and so voracious is its appetite, that a shrub will be completely stripped of its foliage in two or three

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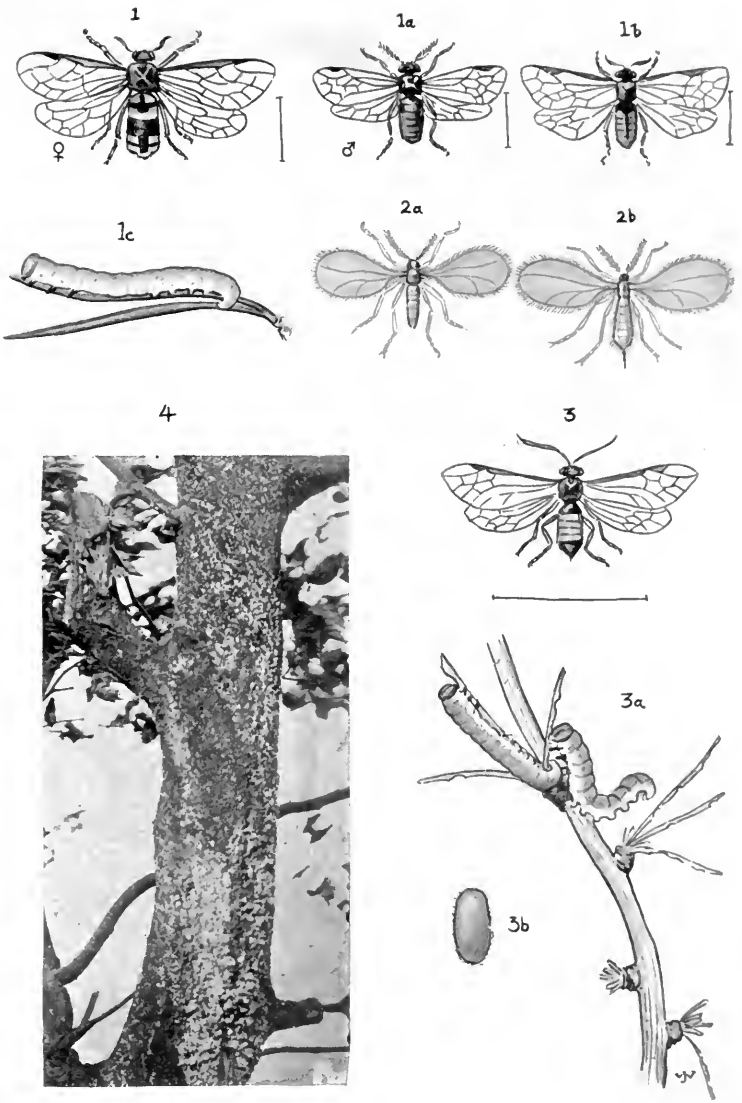

1, 1*a*, 1*b*, 1*c*. PINE SAWFLY AND CATERPILLAR.
2*a*, 2*b*. WILLOW GALL GNATS.

3, 3*a*, 3*b*. LARCH SAWFLY AND CATERPILLAR.
4. THE BEECH COCCUS.

days. Spraying with "XL All" insecticide or petroleum emulsion is the best remedy.

The beech coccus (*Cryptococcus fagi*) is a small yellow insect about the twenty-fifth part of an inch in length, wingless and legless, and it effectually shields itself by constructing around it a white, waxy substance not unlike cotton-wool. These insects multiply in enormous numbers and, having attached themselves to a tree, suck the juices of the cambium layer. Where the insect abounds, the beech soon begins to show signs of the attack in the thin foliage, peeling of the bark, and, when the attack is aggravated, the death of the tree. Hundreds of beech trees have succumbed to the attack of this pest in Hertfordshire and other parts of England. The historic Burnham Beeches, which a few years ago were in danger of destruction, have fortunately been saved by spraying with paraffin and soft soap, an almost impossible remedy where the trees over a large area are affected.

Where oak trees are cultivated, the oak-leaf roller moth (*Tortrix viridana*) is usually present about the beginning of June. It is a very

destructive insect, and attacks not only the leaves but buds and inflorescence, and usually works from the top of the tree downwards. Where only a single or few oaks are attacked, spraying may be resorted to, but hardly any remedial measure can be adopted in a clump or plantation of the tree. Starlings, rooks, and other birds destroy vast numbers of this pest, and should be encouraged.

The lackey moth (*Clissiocampa neustria*), so called from the gay colours of the caterpillar, is another destructive woodland pest, eating wholesale the leaves of the oak, elm, beech, poplar, and most fruit trees. In April and May the caterpillars are hatched, when the leaves are just unfolding. They form a nest or web of silken hairs, generally amongst the smaller branches, in which they live during the day, sallying forth in the evening to feed on the tender foliage. Being very plentiful, they are usually difficult to deal with ; but hand-picking and destroying the cocoons are the only practicable methods of meeting the evil. Being an enemy of fruit trees, it is also dealt with in the chapter on that subject.

The Winter Moth (*Cheimatobia brumata*) *and the Lime Looper Moth* (*Hybernia defolaria*).—The caterpillars of both these moths are very destructive to the leaves of elms, limes, and willows, but particularly to the buds of the apple tree. When full-grown they descend to the ground, where they cover themselves and become chrysalides, from which the moths appear from October to December. Being almost wingless, it is by no means difficult to prevent their ascending the trees by painting a band of any sticky substance around the stems of the trees that it is expected they might attempt to crawl up. We have said more about this in the chapter on fruit trees.

The thorn fly (*Aphis cratægi*) attacks whole hedges or brakes of quick, especially those in the nursery border, as a rule the younger and more healthy plants first falling a prey to its depredations. Sponging with tobacco water or almost any of the prescribed solutions will rapidly exterminate the fly ; but such work is laborious when a large brake or long hedge of the thorn has to be gone over.

The cockchafer (*Melolontha vulgaris*) is

usually pretty abundant, and does most damage by eating the leaves of the sycamore, beech, oak, cherry, and many other trees. It will also eat the roots of most young trees, but those of pines in particular. The insect is about 1¼ inch long, and of a chestnut-brown colour on the upper part of the body, while the head and sides are of a bronzy green, and thickly covered with yellowish-white hairs.

In April and May the eggs are laid in a hole in the ground about 5 inches deep, and the grubs are hatched in July. They are of a dirty-white colour and much wrinkled. In this state they, however, do but little harm; but, after having changed their skins and remained in a torpid state during winter, come to the surface in spring and eat the roots of almost any plant that comes in their way. They again burrow deeper at the approach of winter, coming to the surface in spring, and, when full-grown, are about 1½ inch long, and almost ½ inch in diameter. The perfect insects do not live more than about twelve days, and are easily known by their heavy, awkward flight towards the evening.

Collecting and destroying the larvæ is recommended.

Coniferous trees suffer greatly from the attacks of insects, and in several cases whole plantations of the Scotch pine and larch have required to be felled owing to the depredations of the pine beetle and other woodland pests.

The Larch Sawfly (*Nematus Erichsonii*).—Of late years, in northern England especially, larch plantations have suffered considerably from the ravages of this insect. The larvæ, which are about three-quarters of an inch long, with twenty feet, resemble those of the pine sawfly and gooseberry caterpillar, and feed on the leaves of the larch. An attacked tree can readily be detected by its partially leafless condition. It would be well, so as to keep this recent importation in check, that a sharp outlook should be kept on young larch plantations during July and August.

The pine beetle (*Hylesinus* (*Hylurgus*) *piniperda*) is a dread enemy to not a few species of Pinus, but particularly to *P. sylvestris*, *P. laricio*, *P. austriaca*, and *P. strobus*. The injury done by this beetle consists in its de-

struction of the leading shoots of the tree it attacks. It enters by boring a hole into the side of the shoot until it reaches the pith, after which the course is directed upwards, and an exit made at the terminal bud. This tunnelling of the shoot so weakens it that frequently during stormy weather it is broken across at the point where the beetle entered. Not only are unhealthy trees attacked by the pine beetle, but young and robust-growing specimens frequently fall a prey to its insidious depredations. June, July, and August are the months when it is most commonly found. The only remedy is collecting and burning the affected shoots—work that requires to be done with the utmost care to prevent the escape of the wary insect. Burning all brushwood in plantations is a great preventive.

Wherever Scotch pines are grown the beetle is usually abundant, and at Bostal Wood, in the Metropolitan area, its attacks on these trees have been persistent and severe for many years.

On the Woburn estate, the writer had to cut down about seventy acres of a Scotch pine

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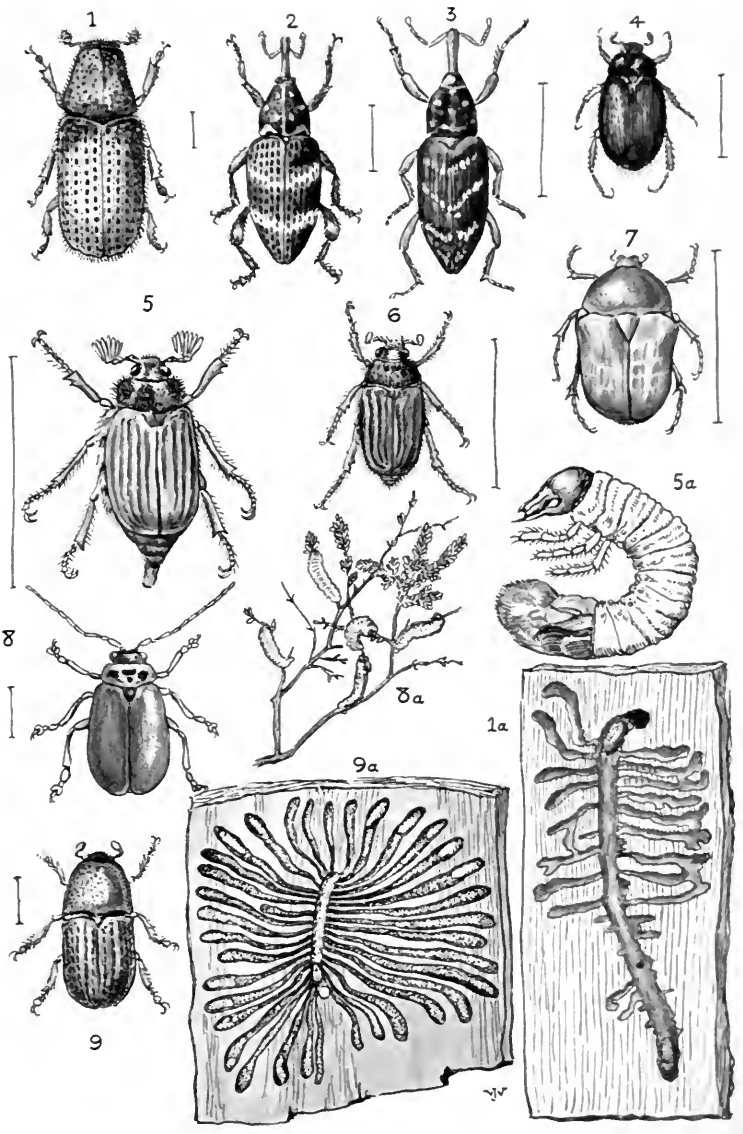

1, 1*a*. PINE BEETLE AND GALLERIES.
2, 3. PINE WEEVILS.
4. GARDEN CHAFER.
5, 5*a*. COCKCHAFER AND GRUB.
6. SUMMER CHAFER.
7. GREEN ROSE CHAFER.
8, 8*a*. HEATHER BEETLE AND GRUBS.
9, 9*a*. ELM BARK BEETLE AND GALLERIES.

plantation in order to assist in getting rid of this troublesome beetle.

The pine weevil (*Hylobius abietis*) is another destructive insect, and differs from the former in waging its attacks against the buds of the leaders and branches, as also eating patches of the bark here and there on the stems and branches. The various species of Abies suffer most, but the pines occasionally are attacked as well. It is always most destructive in young plantations growing on the margins of old woods, and equally bad amongst trees that have been planted on the site of a former pine plantation. The beetle is about half an inch long, and nearly black. One remedy, probably the best, is to place fresh pieces of pine bark on the ground beneath the infested trees, and, by shaking the trees and examining the traps the following morning, many may be destroyed.

Bostrichus typographus is another pest of our woodlands, and may frequently be seen, like fine white wool, spreading over the stems and branches of the silver and other firs. It spreads with terrible rapidity, first appearing in small

patches here and there on the bole, and particularly on the under sides of the branches. The infested tree soon becomes unhealthy, and frequently dies off prematurely. Trees growing in low-lying, heavy ground would seem to fall a ready prey to this insect. *Bostrichus laricis* is nearly allied to the former, but its devastations, which are, however, not very deadly, are principally confined to the larch. It is usually known as the "larch blight." Spraying with Bordeaux mixture has been successful.

The pine shoot moths (*Retinia buoliana* and *R. turionella*) would seem to be more plentiful in this country than is generally supposed. Quite lately, we visited a large plantation of young Scotch fir, the terminal buds of which were greatly injured by the caterpillars of these elaborately coloured moths. The moth lays its eggs at the base of the buds, and into these the caterpillars enter by hollowing out the centre, thus destroying the vitality and causing them to take on a withered appearance and to feel soft and empty to the touch. Trees infested by this insect resemble greatly, in their stunted shoots and exudation

of resin, such as have become a prey of the pine beetle; only in the latter case it is the fresh young shoot and not the bud that is attacked. The *Retinia* would seem, from notes and observations, to be most abundant in what might be termed neglected fir plantations, that is, where the trees have suffered from overcrowding, and if growing under unfavourable conditions as to soil, etc., and particularly when the wood is composed entirely of one species. There is no method of dealing with large infested areas, for the attacked trees have repeatedly been cut over and removed without any seeming diminution in the numbers of the insect. One experiment with a small infested area has been rewarded with good results by lighting a fire to windward, and causing the smoke of coal-tar to pass amongst the trees. This might be worth trying in the case of fruit trees infested by particular insects.

The Larch Miner (*Tinea* (*Coleophora*) *laricella*). —Few, other than those specially interested in tree diseases, have the remotest idea that the yellow, withered appearance of many of our English larch plantations is due to the larvæ

of the above tiny moth. It usually attacks young trees, say, from five to twenty years old, and although it may not kill them outright, yet the repeated onslaughts year after year tend to keep the trees in an unhealthy condition, and so render them liable to other and more deadly diseases.

Unfortunately, the attacks of the larch miner are by no means confined, as is usually supposed, to trees growing under unfavourable conditions, for we have during the past season noticed, in an unusually healthy, fast-growing plantation in Sussex, that almost every tree was more or less affected. Certainly in another large extent of larch in Gloucestershire which was examined a short time ago, and where nine-tenths of the trees were being ruined by the *Peziza*, the larch miner was very abundant ; but it is probable that young trees, whatever be the state of health, suffer alike, although, where hard-wooded species form a portion of the crop, the larch certainly suffers less than when grown in pure woods. The moth lays its eggs at the end of June on the needles of the larch ; the caterpillar, mining into and

feeding upon the interior of the needle, causes it to turn faded and yellow. It lives in the tube thus formed during the winter, changing to a pupa, and ultimately to a moth. It is a most difficult matter with this insect—as, indeed, with all others that are fairly abundant—to suggest a remedy, and we have looked over and examined larch plantations that are differently situated in many respects to find out under what conditions the attacks are most persistent, but with little or no success—healthy and unhealthy, native or Tyrolese, suffering alike when grown as a pure crop.

Where the larches are intermixed with hard-wooded trees—sycamore, oak, and beech—the attacks are certainly less frequent, and this we have now noticed in a number of cases. Trees growing at high altitudes do not seem to suffer less than those at only a few feet above sea-level, and to this point particular attention has been paid. Whether the wounds caused by this insect will serve as a nidus for the spores of *Peziza Willkommii* has yet to be determined, but special importance should be attached to all larch-feeding insects, and their

depredations minimised to as great an extent as possible.

The willows all over and around London have suffered greatly during the past five years from the attacks of the insect *Eriophyes triradiatus*, or the "witch's broom" of the willow. So far as is known, the insect is new to Britain, and was first recorded from Regent's Park about nine years ago. It attacks several species, including the white, crack, Bedford, Huntingdon, and various hybrid willows; and on some of the trees hundreds of the moss-like growths, which vary in size up to 15 inches in length, may be seen. When badly attacked, the trees wear a thin, unhealthy appearance, and in some instances have succumbed to the draining influence of the insect. We have tried several methods of dealing with the pest, but the only successful one was the removal and burning of all affected branches.

The best remedy is pruning off all affected twigs in the early autumn—work that can very well be done in the case of single or a few trees, but which is almost out of the question where hundreds, as in some of our parks, have

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"WITCH'S BROOM" ON THE WILLOW.

been attacked. Satisfactory results have been so obtained, and trees that were pruned experimentally three years ago have, so far, been subjected to no further attacks of the insect. It is, however, a slow and tedious process that can only be extended to lawn trees or such as are valuable from their ornamental appearance or associations.

The caterpillar of the cabbage moth (*Memestra oleracea*) attacks the leaves of the ivy, and is particularly destructive in London and the suburbs. During the autumn months the leaves of infested plants are eaten to the midrib and wear a most unsightly appearance. Syringing with "XL All" insecticide or dusting with hellebore will effect a cure.

The Ash Bark Beetle (*Hylesinus fraxini*).—Ash trees that are growing in unsuitable soil most often fall a prey to this beetle, which is commonly distributed all over the country. Healthy poles are also attacked, but the main depredations are confined to such trees as are in an unhealthy condition, whether from old age or unsuitable surroundings.

About the beginning of May, the beetles,

which are about an eighth of an inch long and brownish in colour, bore into the stem and larger branches for egg-laying. The larvæ, of a purplish colour, with brown head and jaws, quickly hatch, and the perfect beetle appears in August, the exit holes having the appearance as if the bark was riddled with shot.

Ash logs that are allowed to lie about in a plantation are the favourite haunts and breeding ground of this beetle. Preventive measures should be adopted in keeping this insect in check, such as by keeping the woodlands free of dead and dying ash timber, and removing and burning infested bark during the summer months. Two nearly allied species, the black ash bark beetle (*H. crenatus*) and the ash branch beetle (*H. oleiperda*) are found in Britain, but their depredations are little dreaded by the woodman.

Tetropium gabrieli.—This beetle, which was first recorded in Britain in 1902, is very destructive to larch timber, and is now reported from many parts of the country. The eggs are deposited in fissures of the bark, producing

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INSECT ATTACK ON OLD OAK TIMBER.

grubs which are of a yellowish-white colour, with a dark head, and half an inch in length, while the fully developed beetle is fully half an inch long and jet-black in colour. The grub forms circular tunnels three-tenths of an inch in diameter in the timber of the larch, thus rendering it unfitted for structural purposes. There are good examples of the grub, insect, and injured larch wood, from Sutton Park, Staffordshire, in the insect house at the Zoological Gardens, Regent's Park. Plugging the holes with cotton-wool steeped in cyanide of potassium has been tried with good effect.

The Deathwatch (*Xestobium tessellatum*).—The ravages of this beetle are almost entirely confined to old oak timber, such as beams and rafters, though it has been known to attack standing trees of the same kind. The beetle lays its eggs in the holes which it bores, and the grubs form tunnels in the woodwork, feeding as they proceed. To get rid of the insect, an ounce of corrosive sublimate dissolved in a pint of methylated spirit of wine, injected into the holes by a syringe, will be found useful. Closing the holes after injecting

the liquid, by means of clay or putty, is to be recommended.

The ash coccus (*Apterococcus fraxini*) usually attacks trees that are growing on warm, gravelly soil, as does also the felted white scale coccus (*Chionaspis*). The scale is readily detected on the bark, as they present a white, felty appearance, and if pressed emit a red, blood-like fluid. Scraping the affected parts and applying a caustic alkali solution or soft soap and paraffin will effect a cure. The white scale coccus also attacks the willow.

The Willow or Osier Beetle (*Phratora vitellinæ*).—This is a small bronzy-green or copper-coloured beetle about a sixth of an inch long, and often found where willows for basket-making are cultivated. Its attacks are principally directed at the foliage, which it either skeletonises or totally destroys, and osiers so attacked are weakened in consequence. Not only is the osier attacked, but several species of tree willow and many members of the poplar family. In the case of osier beds, spraying with Paris green wash has had beneficial results; and with young plants in the

nursery, shaking the beetles from the foliage during June is to be recommended.

American Blight or Woolly Aphis (*Schizoneura lanigera*).—This commonly attacks the wild crab and other trees, and in certain instances around London some of the shoots appear quite hoary with the tufts of woolly matter where the colonies of insects are situated. This is particularly the case with forms of the Siberian crab, members of which have of late years been removed from some of the London parks owing to the persistent attacks of the aphis. Spraying with a strong solution of soft soap and paraffin has had good results, but the best way is to cut down and burn badly infested trees, as the insect spreads rapidly to adjoining specimens. It is a pest of orchard trees, and is described in connection with "Fruit Trees and their Enemies."

The Weymouth pine (*Pinus strobus*) suffers severely from a species of coccus which of late years has spread with terrible rapidity in almost every part of the country. In certain instances the trees have been so badly infested that whole woods have been cut down and burnt.

Syringing with a fairly strong solution of soft soap and paraffin at intervals during the winter and spring months has been attended with good results, but such treatment can hardly be extended to a whole plantation of the tree. The attacks are worst where the pine is growing in close woodland, and admitting plenty of light and air to the tree is attended with beneficial results.

When growing on light gravelly soil, the stem of this pine is apt to become "pumped" or rotten at the core, for which disease only a change to suitable soil can be recommended.

Larch Shoot Moth (*Argyresthia atmoriella*).—Judging from the specimens that have been forwarded for identification, the larch shoot moth would appear to be widely distributed over England and southern Scotland. It is, however, only of late years that the insect has appeared in quantity, or that its depredations have caused serious loss in larch plantations. Fortunately, where the larch trees are in a healthy condition attacks are perceptibly restricted, whereas on low-lying ground and on gravelly soils the appearance and rapid spread

of the insect are confirmed. The attacks are, however, curiously erratic, the trees in one portion of a plantation suffering severely, whereas in an adjoining section, and apparently under similar conditions, not a vestige of the pest can be detected.

It is a small dark grey moth, less than a quarter of an inch long ; while the caterpillar is about the same length, of a dirty-yellow colour, the head being black. The larva burrows beneath the bark of the younger shoots, and finally works its way to the centre of the stem, causing the death of the affected part. Several preventive remedies have been tried in the case of single trees, such as spraying in early May, at which time the eggs are deposited on the young shoots, with petroleum emulsion. Smoke from burning branches has been successful in restricting the attacks of the insect, but in the case of a whole plantation such remedies are out of the question. In thinning a plantation, removal of as many injured trees as possible is recommended, and in the nursery pruning off affected shoots has had good results.

The tree wasp or giant sirex (*Sirex gigas*) is one of the most persistent and injurious of boring insects, attacking the Scotch pine and sometimes the larch. It is a beautiful insect, 1½ inch long, of a black colour relieved by golden bands. Generally, too, felled trees, or such as are somewhat sickly, are chosen by the female in which to lay her eggs. These are deposited beneath the bark by means of the powerful ovipositor, and in course of time the whitish cylindrical maggots make their appearance. The maggots feed in the solid wood, making holes that are about a quarter of an inch in diameter by means of their powerful jaws. We have known not only the Scotch pine and spruce to be attacked by this formidable insect, but quite a number of larch planks were forwarded to us from northern England that were rendered worthless as timber owing to the attacks of the giant sirex. Prevention is better than cure in dealing with this insect, and fallen and felled trees should be removed from the woodlands as quickly as possible. Weakly or damaged trees and old stumps should also be dealt with. The tree

wasp is common on the outskirts of London, and its borings may be seen on some of the old and diseased Scotch pines on Hampstead Heath. Owing to the borings or holes being perfectly circular in shape and the edges sharply defined, they are readily distinguished from those of any other timber-destroying insect.

The Pine Sawfly (*Lophyrus pini*). — Fortunately, this insect is not abundant in the British Isles, though on the Continent the damage it does in the pine forests is by no means inconsiderable. The insect may readily be recognised by its wide, flattish body, and usually dark appearance. Having attained to full size in the trees, they form cocoons among the foliage or on the stems, and remain in this condition until the following spring, when, in April or May, the perfect insects make their appearance. The male is considerably smaller than the female, while the full-grown caterpillar, which is of a greenish-yellow colour, with a row of black spots on either side, is about an inch long. The remedial measures are not at all easy, especially when a large number of trees are attacked; but single

specimens may be entirely cleared by shaking the caterpillars into a sheet placed beneath the tree.

Wireworms.—These occasionally do a great amount of damage in beds of seedling trees, particularly conifers, and in some instances they attack and destroy the seeds before germination. In the case of young conifers they are gnawed completely through just above or at the ground level, the beds in many instances being strewn with the debris. Seedlings of *Abies nobilis* and *A. Nordmanniana* suffer to a great extent, and in the case of a newly formed nursery or freshly made up seed-beds the attacks of the wireworms are always most pronounced. In the case of fresh nursery ground, paring off and burning a couple of inches of the top soil in the autumn has been attended with excellent results, as has also dressing the ground with gas-lime. When seedlings are attacked, trapping with sliced carrots, mangold, or potatoes, varied with pieces of oilcake as a bait, is to be recommended. Dressing the seeds with red lead is very advantageous to prevent not only wireworms

but birds and mice from attacking freshly sown quantities. Injury from wireworm is not likely to cause any serious consequences after the second year's growth of the plants, especially if the ground has been kept clean and free from weeds during the egg-laying season in June.

The Heather Beetle (*Lochmæa saturalis*).—Of late years this beetle has been terribly on the increase in Scotland, where the heather over large areas has been killed outright by its attacks. It was first described from Scandinavia in 1866, and in Scotland appeared about twelve years ago. During the past five years, however, it has increased at an alarming rate, and large areas of heather, particularly in Ayrshire, Lanarkshire, and Renfrewshire, have been completely killed out owing to its attacks.

The Earl of Dalkeith informs me that "on the Duke of Buccleuch's Dumfriesshire moors, a large amount of heather has been attacked by the beetle. In one case, almost the whole of one beat has been very badly attacked, and in another case a considerable area of another beat. In both of these instances the heather

was burnt next spring, and has come away very well; but where it is attacked in small patches amongst bent or grass it is often not noticed, and in these cases is, I think, very likely, entirely killed."

The beetle is rather under a quarter of an inch in length, and of an olive-brown colour, with black, shining head. The newly hatched grub is one-twelfth of an inch in length, and of a pale-greenish colour. The breeding place of the beetle is generally amongst the sphagnum, and it has been recorded that heather on a damp moor is more liable to attack than when the reverse conditions obtain. Drainage of the ground is therefore all-important, and burning the affected heather is also recommended. Spraying with "XL All" insecticide in June has been found to destroy the insect, but this is impossible over a wide area.

The Oak Apple Gall Wasp (*Cynips querci*) occasions the well-known and widely distributed "oak apples" or "gall apples" which are found, often in large numbers, on the under sides of the oak leaves. They are at first of a dull green, then red, and die off of a leathery-

brown colour. Collecting and destroying these marble-like growths is the only remedy.

The above are only a few of the many insects that injure forest trees; but those treated of are such as are most familiar to the forester, and whose attacks he has most frequently to wage war against. Remedial measures are frequently of little avail, more particularly when a whole wood or plantation is attacked; but with single specimens the numbers may readily be lessened by the methods suggested. Keeping the woodlands free of dead and dying trees and branches is a preventive of insect attacks that should never be neglected. As showing the injury that can be inflicted on our forest trees by some of these insect pests, the following cases may be mentioned.

During a period of fifteen years, the spruce in East Prussia, Poland, and Russia was killed over an area of 7000 square German miles; while in the Bavarian forests the loss to the revenue in one year was £40,000. In both cases the destructive insect *Liparis monacha* was the cause of injury.

Birds, especially the starling, woodpecker, rook, pheasant, and partridge, are valuable for destroying the larvæ of many insects, and should be encouraged. Both the partridge and pheasant eat numbers of wireworms ; the starling, multitudes of the oak-leaf roller moth ; while both bark- and wood-boring insects are devoured by the woodpecker.

CHAPTER IX

INJURIES FROM ANIMALS AND BIRDS

THOUGH not considerable and usually of local occurrence, yet the amount of damage done to trees by animals and birds should receive attention. Red deer, hares, rabbits, squirrels, rats, and mice are amongst animal foes; whilst under destructive birds might be included the ptarmigan, grouse, pigeon, woodpecker, crossbill, starling, and various species of finches.

Buds of most coniferous trees are freely eaten by the blackcock and grouse; the pigeon feeds largely on acorns and beech-mast; while finches and the crossbill devour and destroy quantities of tree seeds, the latter favouring those of the Scotch pine, spruce, and other coniferous trees. The bullfinch preys on the early tender shoots of the larch, and is particularly destructive to the buds of the currant and gooseberry.

The great woodpecker will attack healthy as well as diseased trees, and encircle the stems with rings of holes, which are arranged horizontally. When the trees are badly pierced with lines of holes arranged shelf-like, one above the other, the trunk frequently snaps across during stormy weather, and several such cases were observed in a Kentish plantation during the past season. In the same woodland, however, unhealthy and insect-infested trees of the Scotch and cluster pines were also attacked, and telephone and telegraph poles by the roadside. The holes are usually two inches in diameter, and extend inwards according to the depth at which insects are to be found. In some cases, as will be seen in the accompanying illustration, the timber of the attacked tree has been entirely removed by the woodpecker, leaving only the bark intact.

Although hurtful by picking holes in living tree stems, it would appear that the utility of the woodpecker, in destroying injurious beetles in unhealthy trees, outweighs any harm it may do in attacking healthy specimens.

Birds undoubtedly do much injury, but the

amount of good they do in the way of destroying insect pests far outweighs the evil.

Starlings are at times quite a nuisance, especially when they congregate in huge flocks at roosting time and foul the ground with their droppings. In several cases the trees in the plantation where these birds roost have either been killed outright or rendered unhealthy by their presence, especially when the birds remained for a lengthened period in the same locality. Two instances have of late come under our notice in which quite a number of averaged-sized trees and their underwood have been killed by the too pressing attention of this otherwise valuable bird. Though in certain cases the trees may not have been killed, yet many of the branches have died off, and the whole frequented part of the woodland wears a decidedly unhealthy appearance. Frightening the starlings by shooting, or lighting some of the material used for smoking out rabbits beneath the trees on which they roost, are the only remedies.

The heron does almost similar damage to trees, and in a heronry in the north of Ireland,

as also in Epping Forest, the trees have suffered greatly, and in some instances been killed outright, by the fouling of these birds.

Squirrels commit damage by eating the buds of hard-wooded and coniferous trees, while young larch and other plantations suffer much in the way of bark-peeling and gnawing of the tender wood. The larch and Scotch pine are most frequently attacked, and whole plantations in Ireland and Scotland have at times suffered severely from repeated onslaughts of this animal. Not only is the bark peeled off, but in the case of young larch plantations the top shoots at a distance of from six to eight feet from the crown of the trees are often irreparably damaged by the gnawing of the squirrel.

The bark all round the stem is gnawed and peeled off, with the result that, upwards from the attacked part, the top dies off, and is broken across in stormy weather. In the case of injured tops, it is advisable to have these carefully cut back to the sound bark, and the strongest side branch substituted as a leader.

Squirrels are particularly fond of the flower-

BIRCH TREE INJURED BY WOODPECKER.

INJURY BY SQUIRRELS.

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ing buds of the horse-chestnut and many coniferous trees, while cones of the same species are by no means exempt from their attacks. Tree stems, when the bark is smooth and sappy, suffer much from attacks of the squirrel, and in the illustration the effects of repeated attacks on branches of hard-wooded trees will be noted. Preventive measures are by no means readily adopted, and shooting or trapping has in many aggravated cases been reluctantly resorted to. Standard, isolated trees of the horse-chestnut and other species may be preserved from attack by tying a band of gorse around the stem, but where there are many trees in close proximity such a method of preservation is out of the question. For nesting purposes bark from the branches of decayed lime trees is often employed.

Rats and mice sometimes damage the bark of both young trees and seedling plants, though their attacks are somewhat local. The vole or water-rat is undoubtedly the most to be dreaded, as it will attack not only seeds and seedlings, but the bark of many species of hard-wooded and coniferous trees. We have

known whole plantations by a river-side to suffer from stem barking, and trees by the lake- or pond-side are most liable to attack. At one time the vole threatened the destruction of the New Forest and Forest of Dean by its ravages, large numbers of oak, chestnut, and holly being barked, and in some instances killed outright by the attack.

In Wales, a young plantation of larch suffered greatly from rats biting off the leading shoots, which were carried in hundreds to their holes close by. Hollies growing by a lake- or pond-side are sometimes attacked, and in certain instances large breadths of the bark have been stripped off by these rodents. We have seen the scarlet oak, white poplar, purple beech, Atlantic cedar, and three other coniferous trees barked by rats along a stream-side in northern Ireland. Trapping or poisoning is to be recommended in such cases. Both rats and mice attack seed-beds and destroy seedling plants. Mixing the seeds, before being sown, with a small quantity of white lead, 1 lb. to 10 lbs. of seed, will ward off attacks.

Regarding the attacks of red deer, hares, and

rabbits, little need be said beyond that these animals are most injurious to young plantations, from which they should be shut out by means of wire netting or other fencing, according to the circumstances of the case.

In park and paddock, horses injure trees by gnawing the bark and branches. The stems of attacked trees should at once be protected by suitable wood or iron fencing. Wire netting, if placed tightly around the trunk, will offer some protection ; but there is danger of the horses' shoes getting entangled in the meshes, especially when the netting is brought too near to the ground. Several compositions, such as tar, creosote, and carbolineum, have been recommended as preventives against the gnawing of horses ; but the only effectual remedy we have found is to paint the tree stems with liquid clay and asafœtida in the proportion of a teaspoonful of the tincture to half a bucketful of clay dissolved in water.

Wood pigeons devour not only large quantities of acorns and beech-mast, but will also eat the berries of the elder and holly. Buds of the lilac and plane, as also flowers of the pink

hawthorn, suffer much from attacks of the pigeon, and during the spring of 1916 the depredations in the case of the lilac and hawthorn were so considerable in the Metropolis that special preventive measures had in some cases to be adopted.

The crossbill feeds on the seeds of several coniferous trees, principally those of the Scotch pine and spruce, and when large flocks of the bird appear the injury done is considerable. In pine plantations in the north of Ireland, the crossbill committed such an amount of damage some years ago that reduction of their numbers had to be resorted to by shooting. Comparatively speaking, the crossbill is a rare bird and of local distribution.

The capercaillie, blackcock, and moorfowl or ptarmigan are all inhabitants of secluded heathery moors and pine plantations. They feed on the buds and shoots of the Scotch pine and other coniferous and hard-wooded trees, and frequently whilst these are in the nursery border. Both the blackcock and the red grouse feed largely where the heather and whortleberry abound, and when food is scarce they

devour the buds of coniferous and other trees, and catkins of the birch, alder, and hazel.

On account of its extremely shy and retiring habits, the hawfinch is rarely seen, but it is fairly common in the southern English counties. Its favourite food is the seed of the hornbeam, but it will also eat those of the beech, elm, ash, service tree, and juniper. Plum stones and laurel berries are also devoured, and we have known it to feed on hawthorn and holly berries.

The hawfinch may occasionally be seen in the London parks, and a friend has, on several occasions, watched it feeding on the seeds of the hornbeam that grows near Pembroke Lodge in Richmond Park. The damage done is, however, not serious, and this member of the finch family should be preserved wherever it is found.

CHAPTER X

FRUIT TREES AND THEIR ENEMIES

JUDGING from old writings, the care and management of orchard trees would appear to have received a considerable amount of attention even as early as the sixteenth century—a by no means surprising fact when the value of fruit is taken into account, and that the yield was so dependent on the healthy condition of the trees. In a garden book of the fifteenth century we find some quaint instructions as to the best methods of dealing with diseased orchard trees, while at various later periods the question of repairing injured fruit trees, including the apple, pear, plum, and mulberry, is so intelligently discussed that we somewhat reluctantly came to the conclusion that the writer knew nearly as much about the subject as we do to-day.

Fruit trees are liable to many and insidious

diseases that are in the main attributable to accident or the attacks of insect and fungus pests. With the apple, pear, and plum, branch-shedding and hollow stems are not nearly so prevalent as in the case of our larger-growing trees, and this mainly owing to the smaller size to which they attain and the less likelihood of their getting injured during stormy weather. Damage to orchard trees is, however, apt to be brought about by the weight of fruit causing the branches to get torn from the stem, by careless picking of the fruit, and not infrequently through farm stock grazing amongst the trees. Neglect of timely pruning has in such cases been the direct cause of decay and hollows in both stem and branch. The attacks of insects and fungi are, however, most to be dreaded in the case of fruit trees, some troublesome pests being the canker, apple scab, winter moth, and woolly aphis or American blight. Several of the insects and fungi which attack fruit trees do considerable damage in our woods and plantations, and are fully described in the chapter, "Insect Attacks and their Remedies."

The Winter Moth (*Cheimatobia brumata*).—This may at once be classed as one of the main pests of apple orchards. The caterpillar of this now well-known moth does immense damage to the foliage of not only the apple, but plum, pear, walnut, and other fruit trees. About the beginning of April the eggs, which are laid in crevices of the bark, commence to hatch, and may be seen suspended by threads between the branch tips and the ground. The caterpillar, when fully fed, varies from a half to nearly an inch in length, and is of a greyish-green colour, with narrow stripes on each side. It descends to the ground in June and becomes a pupa, from which the moth emerges about the end of October or the beginning of November. The female, being incapable of flight, must ascend the trees by crawling up the stem, advantage of which is taken to place grease-bands around the trunks in order either to capture her or arrest her ascent.

The band is made of tough, grease-proof paper, which is sold in long strips 5 inches wide. Usually the paper is placed around the tree stem at a height of $3\frac{1}{2}$ feet, except in the

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GREASE BAND ON APPLE TREE.

case of tall-stemmed trees, when, in order to protect them from cattle grazing in the orchard, a height of 5 or 6 feet is to be recommended. The paper may either be pasted to the tree stems or attached by a cord at top and bottom of the band, care being taken that it fits tight, in order to prevent insects crawling between the band and bark. Ordinary cart-grease of best quality should be smeared on the paper, a narrow, thick band being preferable to a wide, thin dressing. The best time to apply the grease-bands is the beginning of October. Hone's fruit-tree dressing is preferable to cart-grease, and an American composition named "Bandits" is also recommended.

A weak emulsion of arsenate of lead, or 10 oz. of Paris green to 20 gallons of water, will be found a useful winter preparation for spraying infested trees.

The woolly aphis or American blight (*Schizoneura lanigera*) is another pest of orchards, but usually where the trees have been neglected. This insect is of small size, and readily recognised by the white cotton-like threads with which it is encased. Its attacks are confined

to the trunk and branches, and give to the trees the appearance of being covered with cotton-wool. It spreads with terrible rapidity, and by exhausting the trees of their sap renders them particularly liable to canker and other fungoid attacks. Fortunately, the ravages of the woolly aphis are readily counteracted by an application of Abol insecticide. In the case of old trees, scrubbing with a brush and soft soap or weak paraffin emulsion during summer has been found a cheap and quick way of getting rid of the pest. As the insect, both in the egg and adult state, is found wintering at the base of the tree stems, an application of carbon disulphide to the soil will be found effectual in destroying the pest.

The codling moth (*Carpocapsa pomonella*) attacks the fruit of the apple, and sometimes appears in such numbers in certain districts that the crop is literally spoiled by its depredations. The caterpillar, or maggot, as it is more frequently called, deposits her eggs on the fruit as soon as it is formed. Soon the larva appears and, entering the fruit at one

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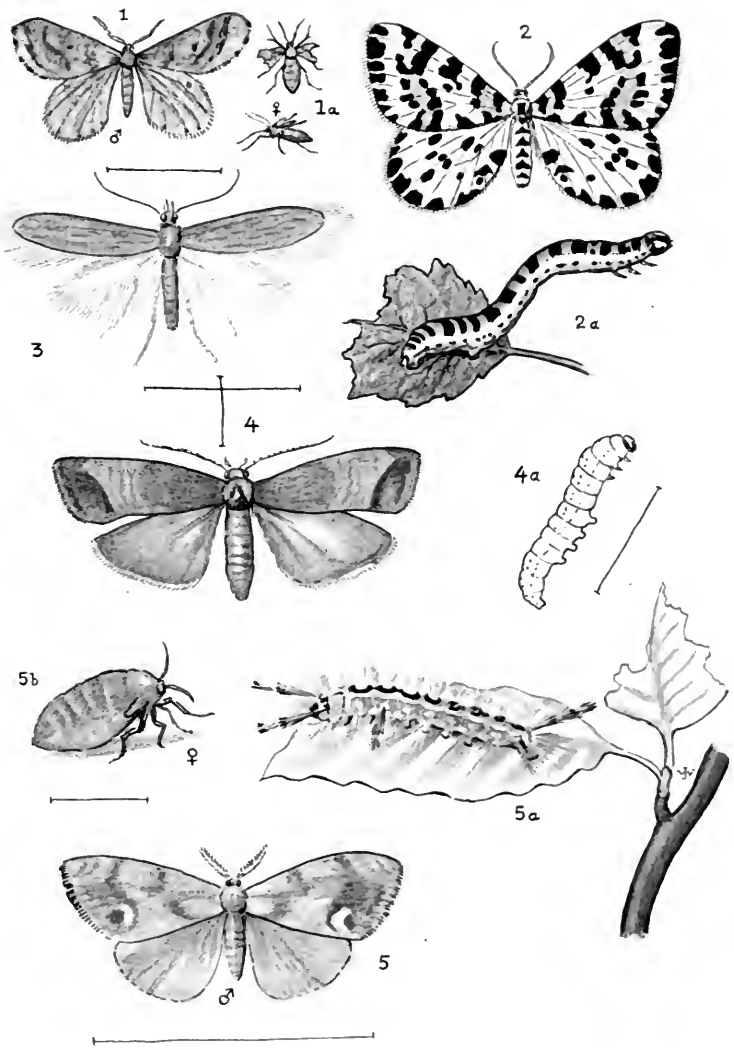

1, 1*a*. WINTER MOTH.
2, 2*a*. GOOSEBERRY OR MAGPIE MOTH AND CATERPILLAR.
3. PITH MOTH.
4, 4*a*. CODLING MOTH AND CATERPILLAR.
5, 5*a*, 5*b*. THE VAPOURER MOTH AND CATERPILLAR.

end, tunnels its way to the core, with the result that the apples fall prematurely from the tree. When full-grown, the caterpillars usually emerge from the fruit and either crawl down the stem or lower themselves to the ground by fine silk-like threads. Remedies consist of spraying with Paris green, in the proportion of 10 oz. to 20 gallons of water, or arsenate of lead, immediately the fruit has set. Fallen apples should be collected and destroyed, and the rugged and loose bark of the trees scraped and scrubbed with a strong brush and caustic emulsion.

The apple sawfly (*Hoplocampa testudinea*) attacks fruit in an almost similar way to the better-known codling moth. Spraying with arsenate when the fruit is set usually effects a cure. As the grubs hibernate in the soil, an injection of carbon disulphide at the root is recommended. Unlike the codling moth, which it much resembles in its methods of attack, the apple sawfly hibernates in the soil and not on the bark of the affected tree. Appearing with the blossoms, the female sawfly deposits her eggs in these, and the larvæ, hatch-

ing out in June, enter the young fruit, causing them to fall to the ground.

The apple sucker (*Psylla mali*) has been very destructive of late years in the orchards of southern England. The insect, by entering a blossom or leaf-bud, arrests its growth and brings about its decay. Spraying the blossoms with tobacco solution, or the larvæ in autumn with paraffin emulsion, has been found beneficial.

Both the goat moth (*Cossus ligniperda*) and wood leopard moth (*Zeuzera æsculi*) damage fruit trees by boring into the stem and branches. In the chapter on "Insect Attacks and their Remedies" the recognition of each, and the best means of dealing with the pests, are fully considered.

The Lackey Moth (*Clissiocampa neustria*).—The caterpillars of this moth, which is about an inch and a half in length and of a bluish-grey colour, have of late years done much damage by eating the foliage of the apple and cherry. The eggs of the lackey moth are carefully arranged in bands around the smaller branches, and are so conspicuous as to be easily

detected. Pruning off and destroying all shoots in which eggs have been deposited is the usual course of treatment before hatching has commenced. When the caterpillars appear they may be readily collected in the webs in which they congregate when not feeding and during dull weather. Spraying with Abol insecticide will kill the caterpillars, but the eggs resist even the most powerful winter washes. This pest has also been referred to when dealing with forest trees.

Aphis, several species, attack the leaves of fruit trees, the most persistent being the leaf-curling aphis (*A. pomi*), the rosy-leaf aphis (*A. sorbi*), and the blossom and leaf aphis (*A. fitchii*). The two former, by attacking the leaves, cause them to curl up, and to become discoloured and sticky with excreta from the insect's body. The red or yellow colour of the injured leaves has given the popular name to the rosy-leaf aphis. Spraying with weak paraffin emulsion about the end of April, before the leaves curl up, is to be recommended. Autumn spraying with strong paraffin emulsion has also proved successful in dealing with

these insect pests. The following formula is highly recommended in the case of aphides generally, but the rose aphis in particular :— Nicotine sulphate, ½ oz. ; whale oil soap, ½ lb. ; water, 5 gallons.

The Oyster-shell Bark Scale (*Aspidiotus ostræformis*).—This scale insect attacks most of our fruit trees, including the apple, pear, plum, and cherry. It may readily be detected by the shield or covering, which bears a resemblance in miniature to an oyster shell, being only about one-twelfth of an inch in diameter. Usually occurring in large numbers on the bark of infested trees and living on the sap, the health of the specimen soon gives way, and in cases where the attack was aggravated we have known the tree to be killed outright during the third year. Fortunately, this scale insect may be kept in check by timely applications of paraffin emulsion to the bark of infested trees.

The Mussel Scale (*Mytilaspis pomorum*).—Amongst scale insects this is one of the most troublesome, not only in the case of fruit trees, but several species of thorn and allied

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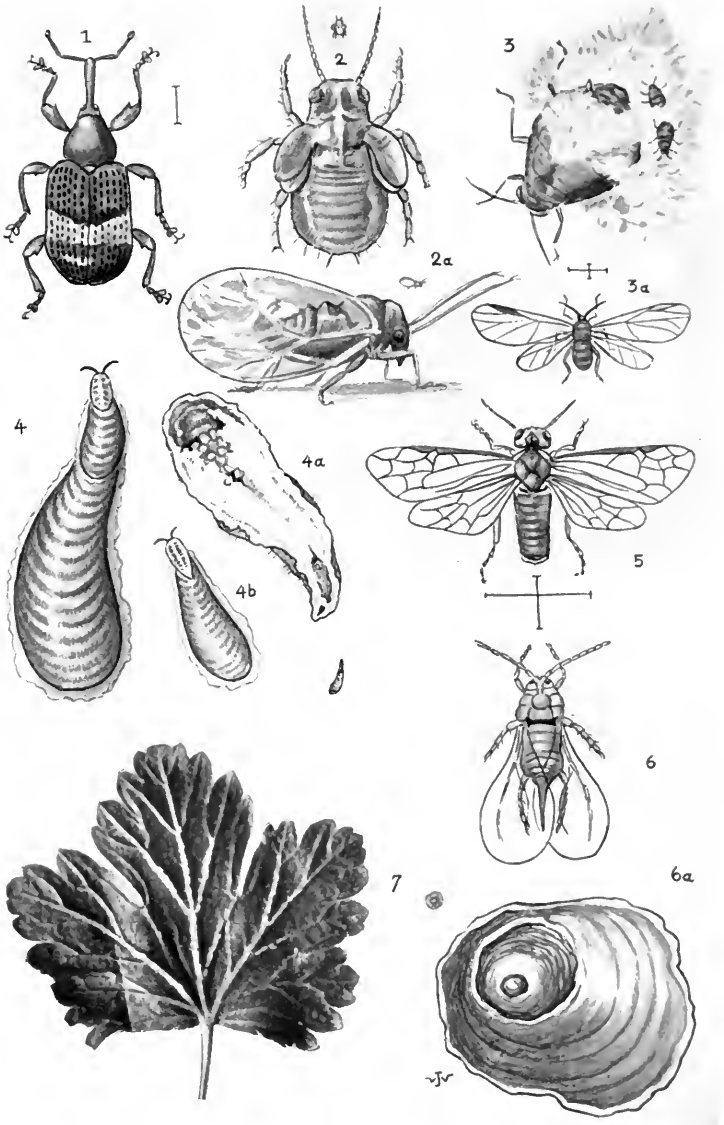

1. APPLE BLOSSOM WEEVIL.
2. APPLE SUCKER, SHOWING (*2a*) PERFECT INSECT.
3, 3*a*. WOOLLY APHIS.
4, 4*a*, 4*b*. MUSSEL SCALE.
5. APPLE SAWFLY.
6, 6*a*. OYSTER-SHELL BARK SCALE
7. GOOSEBERRY SAWFLY EGGS ON LEAF

shrubs. The popular name has been given on account of the shield or covering of the insect resembling a mussel. The insects appear in June, and damage the trees by sucking the sap. Preventive measures consist in keeping orchards free from dead and dying wood and removing loose bark from the trees. Winter treatment with the Woburn wash is also recommended.

The Apple Blossom Weevil (*Anthonomus pomorum*).—Early in spring this little ashy-grey weevil makes its appearance in the apple orchard, where its attacks have greatly increased of late years. It is only about a quarter of an inch in length, and varies in colour from grey to black, with a distinct, wide V-shaped marking on the back. The female bores into and deposits its eggs in the flower-bud, and the maggot, which is of a dirty-white colour and an eighth of an inch in length, attacks the opening flower, which usually falls to the ground. As a preventive measure to the increase of this insect, all withered blossoms should be collected and burnt, and the trees treated with kerosene emulsion or lime-salt wash during winter.

The Magpie Moth (*Abraxas grossulariata*).—This, one of the commonest and most destructive of its family, derives its popular name from the beautiful black and white markings on the wings, which resemble those of the magpie. The body of the insect is about an inch long, and the wings, when fully expanded, $1\frac{3}{4}$ inch from tip to tip. The caterpillar is particularly destructive to the leaves of the gooseberry, though frequently the foliage of the plum and other allied fruit trees suffers from its attacks. It is $1\frac{1}{4}$ inch long, and, like the moth, distinctly marked with black and white, while an orange band runs along each side of the body. In early spring the caterpillar devours the freshly developed leaves, and when full-fed about midsummer turns into a pupa, from which emerges the moth in mid-August. The most approved remedy is an application of arsenate in spring and autumn. Liming the soil beneath the tree is also to be recommended.

The Vapourer Moth (*Bombyx* (*Orgyia*) *antiqua*).—Few British hard-wooded trees are exempt from the attacks of the caterpillar of this widely

dispersed moth. In and around London the insect is fairly common, the caterpillar being readily recognised by its gaudy appearance. It is of a dark grey colour, spotted with reddish, conspicuously hairy tufts, especially at head and tail, and is 1½ inch long. The female is wingless, and the male fully an inch in spread of wings, and of a chestnut-brown colour. The caterpillar feeds on the leaves, and may be destroyed by spraying with a weak solution of arsenate.

The Plum Aphis (*Aphis pruni*).—Wherever plums are cultivated this aphis is usually abundant. By piercing the leaves these are caused to curl up and shield the insect, thus to some extent preventing measures for its eradication being successfully taken. As the aphis appears before expansion of the leaf, spraying with a weak emulsion about the end of March is to be recommended.

Canker, or Canker Fungus (*Nectria ditissima*).—A Kentish fruit-grower tells me that canker, which is due to the above-named wound parasite, is a terrible scourge of orchard trees throughout England generally, but particularly

the south and west. In the case of both orchard and forest trees the term "canker" is, however, very loosely applied whenever the bark and wood are in a diseased condition, though in the present case it is understood to refer directly to attacks of the above-named fungus. Amongst fruit trees, the apple is most liable to the attacks of canker, though both the pear and plum are by no means exempt, and certain kinds of each are far more susceptible than others to the ravages of this fungus pest. The first appearance of the disease is not very marked, in which the bark looks as if gnawed or eaten away, thus exposing the wood to view. Gradually the bark around the wound splits into fissures, becomes thick and rugged, and assumes a withered brown appearance. Young and tender wood naturally suffers most, and in this case the spread of the disease is rapid and persistent, the bark gradually falling off in flakes, and finally resulting in the death of the branch. As the canker fungus is a wound parasite, it can only gain a footing through injuries to the bark, such as would be brought about by insect attacks, the browsing

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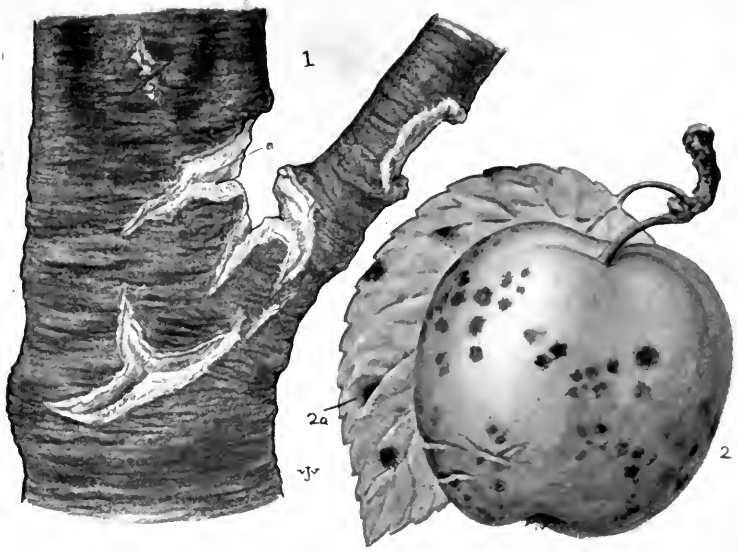

1. CANKER ON STEM AND BRANCH DUE TO THE FUNGUS NECTRIA
2, 2*a*. SCAB ON APPLE DUE TO FUNGUS ATTACK.
3. STEREUM PURPUREUM.

of farm stock, or damage to trunk or branch in stormy weather.

The remedies for canker are few and but little understood, which may also be said of the causes which bring about a diseased condition of the trees. Badly affected orchard trees should be uprooted and burnt, while, in less virulent cases, carefully cutting away and destroying the diseased portions and painting the wounds with tar is to be recommended. Preventive measures are best, and consist in spraying the trees with copper sulphate immediately after the fall of the leaf. Sulphide of potassium, in the proportion of 10 oz. to 35 gallons of water, has had good effect when applied to slightly affected trees in some of the Kentish orchards.

Apple and pear scab (*Fusicladium dendriticum* and *F. pyrinum*) cause considerable anxiety to the cultivator of hardy fruit. These are fungi which cause both leaves and fruit to become mottled with dark patches. When attacked, the fruit development is arrested, and in the case of the pear cracking is the usual accompaniment of this fungoid disease. Certain

kinds of apples and pears are more liable to attack than others. Remedies consist in winter spraying with sulphate of copper, 1 lb. to 25 gallons of water, or the Bordeaux mixture applied in summer.

The pear midge (*Diplosis pyrivora*) and the pear leaf blister (*Eriophyes pyri*) both commit damage in fruit orchards, the former causing the fruit of the pear to become distorted and fall off prematurely, while the latter causes the leaves to become blistered and quickly change colour from green to a clear brownish red. Burning infested leaves is to be recommended in this case ; while the midge may be kept in bounds by destroying attacked fruit and top-dressing the adjacent ground with kainit or guano.

Silver leaf (*Stereum purpureum*), which is readily recognised by the silvery appearance of the leaves, attacks the plum, peach, and other fruit trees. It is a fungus growth that gains admission through injuries to the bark of the attacked trees. Preventive measures can only be recommended, and in the case of a whole tree being affected it should be cut down and

burnt. Where the disease has only attacked a few branches, these may be pruned off and the wound dressed with tar.

White Root Rot (*Rosellinia necatrix*).—This destructive fungus, though usually attacking fruit trees, is not entirely confined to such, being found on several hard-wooded and occasionally on coniferous trees. Both the crab and gean or wild cherry suffer much from its attacks when growing in hedge and plantation, and equally so the apple and other fruit trees under cultivation. As the attacks are entirely confined to the roots and lower portion of the stem, the presence of the fungus is not readily recognised, though the premature withering of the leaves for the first two years, and sudden death of the tree during the third season, usually point out that this most destructive of all root pests has been at work. It is readily recognised by the snow-white appearance of the fungus on the roots, the mycelium of which can sometimes be detected between the bark and the wood on the basal portion of the affected stem. Removing the earth from the roots and dusting these with powdered sulphur

is to be recommended, but this must be carried out at an early stage of the attack.

Gumming in Fruit Trees.—The condition of gumming or gummosis may be the result of fungus or bacterium attacks following injury to the bark, or indirectly owing to the trees growing under unfavourable conditions as to the quality of soil, dampness in the ground, or standing in too close proximity to each other. In the case of the gean or wild cherry, the latter condition would appear to encourage its spread, especially when the trees are growing in close woodlands ; but with the cultivated cherry attacks of gumming are also of frequent occurrence.

There is no known cure for gumming, though removal of the cause in soil, site, or prevention of injury is to be recommended. Cutting out badly infested bark and wood and painting with an antiseptic has in some cases been productive of good results.

As well as the above, which are, however, the worst enemies of orchard trees, several others attack and injure fruit trees, but their depredations do not generally extend to a

serious condition. As with our woodland trees, particular attention should be directed to the pruning and dressing of all broken branches and injured bark in the case of orchard trees. Hollow stems may, where practicable, be filled up as recommended in the chapter under that heading at the beginning of this book ; while supporting heavy branches, or such as are likely to get broken over in stormy weather, should receive timely attention by staying or supporting with light iron bands and connecting rods.

CHAPTER XI

PREVENTING DISEASE

Protective and preventive measures in connection with the diseases of trees should be the first and main consideration of the woodman. An injury that would cost but a minimum of time and expenditure to remedy, will in all probability, if neglected, result in the partial or total collapse of a tree.

Numerous examples are not wanting, in our parks and gardens, of elms and other trees that have, through lack of attention when injury to root, stem, or branch befell them, either become unhealthy through the attacks of insects and fungoid pests, or stagheaded and hollow-stemmed before crumbling to pieces.

When attended to in time, trees are wonderfully recuperative when subjected to disease or injury, and respond quickly to efficient

treatment. In previous chapters, the most generally approved methods of dealing with injuries and diseases have been given, but preventive treatment has hardly been touched upon. Preventing disease or accidents, such as by bracing heavy limbs that are likely to fall apart, foreshortening branches that have become top-heavy, dealing with insect and fungus pests, fencing against the attacks of animals, and generally attending to the health of trees by soil-enriching and carrying off superfluous moisture, should receive prompt and careful attention.

Trees suffer in many ways and receive injuries that can only be rightly described as unnecessary, such as, through careless timber felling and haulage, by driving nails and hooks into the stem, and, probably worst of all, from passing waggons, barrows, and mowing machines. Farm stock, horses and goats in particular, as also ground game, do much damage to trees if allowed to roam unmolested, and in the case of young trees the damage is often irreparable. Fencing is the only way of getting rid of the evil, and all standard park

trees, to which browsing animals have access, should be carefully guarded by suitable fencing against their attacks. Driving nails into tree trunks, and attaching fencing to these, are perhaps minor evils, but they should be guarded against as likely to prepare the way for insect and fungoid attacks.

Through carelessness when removing timber from the woodlands many a fine tree has had its exposed roots and the bark of the lower portion of the stem seriously damaged. Then there are injuries due to ignorance and carelessness in pruning and felling, all of which might have been avoided by timely care and forethought. The lawn-mower, or rather the operator, is to blame for many a wound on root and stem; while poisoning of the soil by escaping gas or sewage has much to answer for in the dead and dying condition of many urban and suburban trees.

Periodical examinations should be made of all important trees, in order that preventive measures may, when necessary, be carried out before the health of the tree has been impaired. Trees growing in our public parks should

receive special attention in the matter of an annual examination, and especially is this the case with such brittle-branched trees as the elm and poplar, large limbs of which frequently snap across without the slightest warning and to the danger of visitors. No cursory examination of such trees should be allowed, but every part of the stem and heavier branches carefully gone over, in order to find out where weak spots exist.

It occasionally happens that during warm, still weather heavy limbs of such trees as the poplar and elm snap over without the slightest warning, and often to the danger of those who may be present beneath their shade. Several cases of this kind have occurred of late, and in two instances at least with fatal results. The reasons for this sudden snapping of branches are: (1) disease or injury; (2) disposition and size of branch; (3) the extra weight of foliage during the growing season; and (4) the brittleness of the timber caused by the flow of sap. In some parks and gardens —the Royal parks in particular—an annual examination of the trees is made, and all heavy

and diseased branches either wholly removed or cut back to such an extent that their safety is assured. But even with the most minute and careful examination it by no means follows that accidents will not occur, for the simple reason that it is often impossible to detect flaws and diseases which are not revealed outside the bark. This is especially the case with the branches of old elm trees, the diseased centres of which often defy the most careful examination of the experienced woodman.

Apart altogether from disease or injury, a branch may, for the sake of safety, require to be pruned or lightened. Upright-growing branches are not so dangerous, but such as hang downwards from the horizontal and extend to a considerable distance from the main stem require judicious pruning. This should be carried out in such a manner that the general appearance of the tree is not damaged, the heavy branches being neatly cut back at the point where the operation will be least readily detected. Here again a careful smoothing of the branch surface at the point where amputation took place is all-

important, and tarring or painting should not be neglected, whether for the sake of appearance or the health of the tree. The extra weight of foliage often causes a branch to become top-heavy and break across, this being accentuated by the presence of an unusually large quantity of sap, which naturally causes the timber to become brittle and more readily susceptible to accident.

The presence of fungus on a tree may be taken as a sure indication that all is not right with the timber, and, so far at least as the public safety is concerned, the sooner such a tree is examined and dealt with the better. Insect attacks, particularly those of the goat and wood leopard moths, are frequently the cause of the sudden breaking of a limb or branch, especially when the tree is in full leafage or during stormy weather. The caterpillar of either insect tunnels into the wood and causes it to become so weakened at the point of attack that it readily breaks over when subjected to the extra weight of leafage or wind-pressure.

Though hardly applicable, from a financial

point of view, to all the trees in a plantation, yet there are not a few instances on lawn and in park in which a liberal top-dressing of loam or vegetable matter will aid materially in bringing to a healthy condition specimens that are suffering from exhaustion of the soil, or where the roots have penetrated into an uncongenial substratum or subsoil which is inimical to the further progress of the tree.

The first symptom in the arrested growth of a tree is an appearance of scanty foliage at the extremities of the top branches. Next season these branches present a still further exhausted look and the tips die back, this going on from year to year until the tree presents a bare, dead appearance, and finally succumbs to its unfavourable surroundings. The only remedy in such cases is stimulating the action of the vegetative powers of the tree, which can best be done by a liberal application of suitable soil and severe pruning back of the dead and dying branches.

Before the application of a top-dressing, the surface soil beneath the tree should be lightly forked over, care being taken not to damage

the roots in so doing. A digging fork is preferable to a spade for this work, and the operation should be carried out, not in circles around the tree stem, but in a line with the direction of root-run. The most suitable top-dressing for the majority of trees is good, sound loam, mixed with leaf-soil or wood ashes, and spread on the surface to a depth of about six inches—much depending on the age and size of the tree to be operated upon—and for a space outwards from the trunk as far as the branches extend. About the fall of the leaf is the best time to apply the top-dressing, the winter rains washing in the chemical agents as food for the roots. In conjunction with the top-dressing, pruning the dead branches from the trees should be taken in hand, the advice given elsewhere about cutting well back to the living wood being attended to.

We have known many instances in which sickly trees have taken a fresh lease of life after being treated as above directed. In some cases ash trees from 50 to 70 feet high, and growing in heavy loam abutting on stiff clay, when so treated after they had shown signs of

incipient decay, as appeared by the dead and dying heads, have recovered their former vigour. Spanish chestnut, oak, and lime over two centuries old have also responded quickly to top-dressing and pruning, after having been allowed to remain unattended for a number of years ; and although now lacking their original wide-spreading branches, they have by the treatment been saved from premature decline. Coniferous trees such as the Lebanon cedar and various species of cypress take kindly to a liberal top-dressing when growing in poor, thin soils.

CHAPTER XII

ACCIDENTS AND DISEASES TO WHICH TREES ARE LIABLE

AMONGST our commonly cultivated trees, it may safely be assumed that every one is liable to some malady, disease, or accident, the various species, however, being in the main subject to different diseases and different kinds of accident. In the accompanying alphabetically arranged list, the notes have reference only to such trees as are commonly cultivated in this country, with special notice of the dangers to which they are subjected, and the best means of dealing with the attendant evils.

Acacia.—Though one of our most beautiful flowering trees, the acacia is short-lived, and, owing to its brittle wood, branches are often broken away in stormy weather. Dead

branches are common on the acacia, and it is liable to fungoid attacks. The timber is of good quality, and lasts well either in or out of doors. On gravelly soils the tree dies out at an early age.

Alder does not suffer from insect attacks, though the larvæ of one of the weevils, by burrowing into the wood, does a certain amount of damage to the timber. It is by no means a long-lived tree, and when grown on unsuitable soil, or in too cold situations, becomes stagheaded. The timber, which is of a beautiful pink colour, is valuable for using under water and for the making of clog soles.

Apple.—Fruit trees in general, but the apple in particular, are subject to many diseases, including canker, insect and fungoid attacks, and various forms of blight. Canker is perhaps most to be dreaded, though insect attacks, especially those of the codling and winter moths, have played sad havoc in many of our English orchards of late years. The attacks of at least four species of fungi have also, particularly in old and neglected orchards, to be contended with ; while boring beetles

which attack both bark and heartwood are particularly numerous where fruit trees are extensively cultivated. As a chapter on the pests of fruit trees is included in this book, it will be unnecessary to enter into further detail on the subject here.

Ash.—Though one of our hardiest trees, the ash suffers much from several cankerous diseases, the ulceration spreading rapidly and causing the timber of the tree to be almost valueless, unless for firewood purposes. After being heavily thinned out, the ash is frequently attacked by the ash coccus, this also putting in an appearance when the tree is growing on light, warm soils. Spraying with paraffin emulsion will usually set matters right, an operation that is next to impossible where trees throughout a plantation are affected. Attention to the soil in which the ash is planted will alone prevent the disease.

Beech.—The beech is a thin- and tender-barked tree, and liable to several insidious diseases, foremost amongst which is that caused by the felted beech coccus (*Cryptococcus fagi*), from which so many trees have succumbed of

late years, in every part of the country. When badly attacked, the bark peels off and the tree dies. Scrubbing the affected bark with soft soap or petroleum emulsion is to be recommended, this remedy having answered well when dealing with the trees in the famous Burnham Forest. The canker fungus (*Nectria ditissima*) frequently accompanies the beech coccus. Seedling beech are somewhat tender and suffer from untimely spring frosts. Being long-lived, a hollow and decayed stem, as in the case of the old tree at Knole Park, will last for several decades if properly attended to. The beech, however, does not stand pruning well, and, unlike the oak and elm, is shy in sending out young shoots.

Birch.—This may be reckoned as one of our hardiest trees, and the least exacting as to soil and situation. It is affected with large fungoid growths, known as birch-balls. *Polyporus betulinus* often attacks the birch, and under its shade the magnificent scarlet *Agaricus muscarius*—which is, however, harmless—is most commonly to be found. By removing the *Polyporus* from the tree and painting the

[*To face page* 188.

REPAIRING A BEECH TREE.

wounds with tar, much good will be brought about.

Catalpa.—Old trees of the Indian bean or catalpa are very apt to become diseased and lose large limbs in stormy weather. They may, however, by forethought in the matter of filling hollow stems and supporting heavy branches, be made to last for years, and the decidedly ornamental character of the tree warrants such a course of treatment. As the catalpa stands pruning with impunity, and is often rejuvenated thereby, old specimens may be cut hard back, with the result that healthy growth will speedily come about. The heavy horizontal branches often break from their own weight.

Cedar of Lebanon.—Cedar wood is rather brittle, which will account for heavy branches getting broken over during stormy weather. It is little liable to disease or insect attack, but suffers from poorness of soil and attacks of root fungus. Heavy branches that are likely to break away from the main stem should receive attention in the way of bracing. Top-dressing the cedar is recommended.

Cherry.—The gean or wild cherry is subject

to no particular disease, though, when growing amongst other trees, at least two species of fungi attack damaged portions of the stem. Heavy crotched branches are apt to get severed from the trunk. Black knot is prevalent in both the wild and cultivated cherry. The only recognised remedy is cutting off and burning affected branches. When such occurs in the stem, cutting out the diseased portion is recommended ; but pruning must be carefully performed in the case of the cherry, as it bleeds profusely. Aim at such a method of treatment that quick healing will be brought about, for constant loss of sap is a drain on the constitution of the tree.

Chestnut (*Horse*) is very liable to have its branches broken over, owing to the brittleness of the wood. It is also subject to fungus attacks, and squirrels eat the young shoots. Wounds occasioned by pruning should receive a dressing of tar every third year until the sore has disappeared. The wood leopard moth attacks the timber.

Chestnut (*Sweet or Spanish*).—Few diseases or insect pests attack this chestnut. Neither is

it liable to have branches broken over, and unless diseased is rarely uprooted. Cup-shake is prevalent in the timber when the tree is growing under peculiar circumstances as to soil, situation, or exposure.

Douglas Fir.—This tree is apt to lose its leading shoot in exposed situations. It is not liable to attack from insect pests, though young trees in the nursery border have been reported as suffering from the presence of root fungus and the pine leaf-shedding fungus.

Elder.—A hardy tree that bears exposure well, and succeeds in maritime and smoky situations. Suffers from canker, and is one of the hosts of the "Jew's-ear" fungus. This, however, is readily removed, and by dressing wounds with tar a recurrence of the attack is obviated.

Elm trees suffer from the attacks of quite a number of insects, notably the elm bark beetle (*Scolytus destructor*), which frequently kills out specimens that are attacked. The insect forms long galleries beneath the bark. Cutting down and burning affected trees is the best remedy. The elm is a comparatively soft

and brittle-wooded tree, and very liable to have heavy limbs broken off during stormy weather. Quite a number of fungi attack diseased elms, but such are noticed under the chapter dealing with that particular pest of our woodlands. As the elm usually breaks into many heavy branches, and the timber is brittle and short-grained, bracing is more necessary in this than any other tree. Owing to exudation, the surface of a wound should be painted every third year, else splitting of the wood and rot are apt to take place. The Cornish elm suffers much from root-rot in London.

Evergreen Oak or Ilex.—Though an excellent tree for exposed situations, yet heavy branches are apt to get broken from old specimens in stormy weather. Bracing is therefore recommended. Little liable to attacks from insects, though fungi take possession of damaged portions of the root and stem.

Ginkgo, or Maidenhair Tree.—Not liable to damage from either insects or fungus, though in isolated cases the roots have been attacked by the latter, particularly the well-known *Fomes annosus*.

Holly.—The foliage often gets damaged by the larva of the holly fly, for which the only remedy is picking and destroying the injured leaves. Owing to root disease, the holly is apt to get blown over by the wind.

Hornbeam.—One of our hardiest trees, and little liable to attack of either insects or fungi, though in the case of pollarded specimens, such as those in Epping Forest, the attacks of both are by no means uncommon. The timber is hard and not apt to get damaged during storms. Dead and dying trees have been attacked by *Stereum* in Regent's Park.

Laburnum.—Subject to the attacks of insects, and, owing to root disease, apt to get partially uprooted in stormy weather.

Larch is subject to many diseases and insect attacks. The well-known and much-dreaded canker is referred to under insect pests, while diseases due to unsuitable soil are by no means uncommon with the larch.

Lime.—This tree has, perhaps, fewer defects than any other. Some insects attack the foliage, but not to an alarming extent. Dead branches are frequent on old trees, but timely

and careful pruning will lessen the evil. Several fungi attack the lime, such as *Nectria cinnabarina* and *N. ditissima*.

Maple.—This is a hardy, small-growing tree that is fairly exempt from injury either by storms or insect and fungoid attacks. The leaves are occasionally rendered unsightly by the presence of numerous black spots due to attacks of the fungus *Rhytisma acerinum*. Collecting and burning the diseased leaves is to be recommended as keeping this pest in check. Another fungus, *Nectria cinnabarina*, attacks the maple, but it is comparatively harmless.

Mulberry.—Few trees require more attention in the matter of pruning and staying than the mulberry. Inclined to send out heavy and often unwieldy limbs, the wood of which is brittle and liable to insect attack, early attention to pruning or foreshortening and staying, where necessary, should be given. Many large and historic mulberry trees are found in and around London, which should be carefully guarded against injury and disease. Being a long-lived tree, it well repays attention.

Oak.—The oak suffers severely from storms

and insect and fungoid attacks, but otherwise is a healthy, long-lived tree. In certain seasons the foliage is attacked by the oak-leaf roller moth, which often strips the tree of its leaves and renders it very unsightly. One of the most destructive enemies of the oak is *Polyporus dryadeus*, which distils the juice of the tree in drops and gradually drains its constitution. *P. quercinus* is not so common, but quite a formidable enemy. Oak timber is subject to "shake," the result of unsuitable soil and situation. Probably no other tree suffers so much from the effects of wind, large branches being frequently wrenched away from the stem, and especially is this the case in old specimens. The Turkey oak is, around London, even more liable to disease than the common species, rot and fungus being not uncommon.

Hollow trunk is prevalent; the best methods of treating such, as also fungi and insect attacks, are given under their various headings. The timber decays slowly, and any work connected with the tree, such as bracing heavy limbs, filling hollows, and attending to insect and fungoid pests, is amply paid for in the

longevity of the "monarch of the forest." If only for the great age to which it attains, the oak is well worthy of special attention in the matter of bracing and filling.

Pear.—The pear is subject to the attacks of several bark- and wood-boring insects, also of fungi, and the heavier branches are apt to get broken over, especially when weighed down with fruit. For treatment refer to chapter on fruit trees.

Pines.—The Scotch pine suffers from many insect and fungoid pests, and when growing on unsuitable soils is frequently "pumped" or rotten at the core. The pine beetle does great damage in young plantations, when cleanliness of the woodlands in the matter of fallen branches is the first preventive. Neither the Corsican nor Austrian pine is subject to disease, though we have known both to suffer considerably from the attacks of the pine beetle.

Peridermium strobi attacks the Weymouth pine, as do several insects that are commonly reported on the larch and other coniferous trees. All the pines are subject to heart-rot, the Weymouth in particular. In replanting

ground from which a crop of Scotch or other pine has been removed, never use the same species.

Plum.—When heavily loaded with fruit, the branches of the plum are apt to get broken. Gumming is a prevalent disease, and insect attacks are frequent. Refer to chapter on the treatment of diseases on fruit trees.

Poplar is a brittle wood; large limbs often get wrenched from the trunk in stormy weather. Both fungus and insects are apt to attack the tree when unsuitably placed. Being a comparatively short-lived tree, no great expense should be lavished on repairs.

Redwood.—Little subject to disease or insect attack. Squirrels remove the bark for nesting purposes. A fungus (*Fomes*) attacks diseased roots.

Rowan, or Mountain Ash.—A hardy upland tree that is rarely injured by storms. Fungus attacks are prevalent on old stems that have become accidentally or otherwise damaged, and the goat moth affects the stems and larger branches of the rowan, as indeed almost all species of Pyrus.

Silver fir canker does much damage to the stem of the tree by forming excrescences which swell and burst the bark, thereby inducing timber wounds. On damp soils the disease is most prevalent, though occasionally on high-lying, sandy land it is both rapid and deadly. Cutting and burning affected trees is the only sure remedy.

Spruce Fir.—Apt to get uprooted when growing on shallow soil, and to die out on that of a dry, gravelly nature. Subject to the attacks of both insects and fungi, the depredations of the well-known spruce gall aphis extending all over the country. The timber on certain soils gets affected by rot.

Sycamore in a young state is a healthy tree and liable to few diseases ; but as it advances in age hollow trunk is frequently to be met with. Around London especially, the foliage of the sycamore is liable to be damaged by a fungus disease due to *Rhytisma acerinum*, in which the leaves are covered with irregular-shaped black spots. These, however, do not appear to affect the health of the tree, but, as they spread rapidly and are by no means ornamental,

disease-infested leaves should be collected and burned as they fall in the autumn.

Thorn.—The foliage is attacked by several insects, and the stems tunnelled by the grub of the goat moth. Cyanide of potassium injected into the holes is a good remedy for the latter, while spraying with "XL All" insecticide will clear the foliage of insect pests. Old trees suffer from root rot, and in consequence often fall a victim to the storm.

Tulip Tree. — During stormy weather, heavily-foliaged branches of the tulip tree are apt to be wrenched from the stem, an evil from which some of the finest specimens in this country have suffered. Bracing is recommended. Fungus is apt to attack the roots of lawn trees that have been damaged by the mowing machine, but this can be remedied by cutting away the diseased portions and painting with tar. Trunk hollows sometimes appear, and should at once be filled with concrete, so as to prevent the ingress of damp and consequent rotting of the stem.

Walnut falls a prey to red and white rot, often becomes hollow, and loses the vitality of

the main anchor roots. Rarely is the dense timber attacked by decay when seasoned; and a peculiarity of the walnut is that, though the trunk may become hollow, the top is quite green. Apt to get uprooted.

Willows of various species, but particularly the most valuable, in a commercial sense at least—the white or Huntingdon (*Salix alba*)—fall a prey, when at all diseased, to fungus and insect attacks. Hollow stem, too, is frequent in old age, and even in young specimens when unsuitably placed; but the tree is wonderfully recuperative, and frequently sends out roots from far up the main stem. Pollard willows often form roots at the crown and send them down to the soil through their own hollow stems, and the same has been noticed in the yew, elm, white bean tree, and mountain ash. No great expense should be gone to in the case of the willow, though bracing branches that are likely to fall away and so mar the appearance of the tree is to be recommended.

In and around London many willows have during the past ten years been attacked by

the "witch's broom," a gall growth named *Eriophyes triradiatus*, which produces moss-like growths and injures the affected shoots. It is described in the chapter on insect attacks.

Yew.—This tree is rarely uprooted by the wind, though during a snowstorm the flat, thickly-leaved branches are apt to get bent down and broken. Being a long-lived tree, hollows in the trunks and heavy branches that are likely to get riven from the main stem should receive attention in the matter of filling and bracing. The yew is little subject to insect attacks, but is occasionally, where disease has set in, the host of that widely dispersed fungus *Polyporus sulphureus*. This should be removed and, after the wound has been thoroughly cleaned of all dead and dying matter, it should be painted with tar or carbolineum.

When only a few trees are attacked by insect or fungoid pests, remedies may usually be applied, and often with success; but in the case of a whole plantation this is quite out of the question. Prevention is best, and in connection with this the following rules should be observed :—

1. Never replant the site of a pine plantation with trees of a similar species. Hardwoods are preferable.

2. Keep the plantations and individual trees clear of dead and dying wood.

3. Tree wounds, however caused, should receive early and careful attention in the way of dressing and painting with tar.

4. Bracing tree stems and supporting heavy and diseased branches are operations that, on certain trees, should receive prompt and careful attention.

CHAPTER XIII

PRESERVATIVES AND MATERIALS

Coal-Tar.—For covering tree wounds, coal-tar, a waste product of gas-works, is perhaps preferable to any other preparation. Coal-tar can be used either on living or dead wood with equally good results, forming an impervious coating that is proof against dampness as well as insect and fungus attacks. The odour is objectionable to all forms of insect life, and effectually wards off their attacks. It is readily applied with a long-handled painter's brush, and should be rubbed well into the diseased or wounded parts of the tree. Usually it is applied cold, but when pruning is being carried out in wintry weather, a slight warming so as to thin the tar may be necessary before it is painted on the wood. A single coating, if well rubbed in, will last

for four years at least; but in the case of extensive wounds that take a long period to heal over, painting may be necessary every third year, in order that surface cracks may be kept filled up, to prevent ingress of water.

Creosote owes its efficacy to the fact that it is one of the most virulent of plant poisons, and wounds painted with the substance are completely protected against the attacks of insects or decay-inducing organisms such as fungi. For painting wounds or the insides of hollow branches and trunks, previous to stopping or filling, it is preferable to tar, owing to its deodorising and disinfecting properties. As a protection against damp creosote is, however, inferior to coal-tar.

Carbolineum is, perhaps, of more value than creosote for rendering wood proof against insect and fungus attacks, and like that substance is inferior to tar for keeping out damp. Other substances, such as sulphate of copper, corrosive sublimate, and zinc chloride, are of value for painting wood, but are more commonly in use throughout Canada and the United States than in this country.

White Lead or Zinc.—The results of experiments that have recently been carried out at the New York Agricultural Experimental Station would suggest that as a covering for tree wounds white lead or zinc is preferable, in so far as the healing is concerned, to either tar, creosote, or carbolineum. An objection to the use of white lead or zinc, in parks and public gardens, is undoubtedly the colour, which so nearly resembles that of the wood that the mark of pruning, which it is often necessary to hide, is not obliterated.

Concrete Filling.—In the filling of cavities or hollow stems, one part of cement to four parts of clean gravel will be found sufficient in making the concrete. As to the method adopted in mixing and filling little need be said, the mason or gardener being usually well up in such operations. In finishing off the filling at the entrance to a cavity, cement only should be used, as this entirely excludes damp, and owing to smoothness of surface allows the cambium and bark to quickly heal over, at least in the case of healthy trees.

Broken Bricks.—Old bricks, broken to the

size of a walnut, are valuable for filling hollow stems or "chimney" openings where the price of concrete filling would be prohibitive. The surface should be covered with concrete. It cannot be claimed for such a filling that it strengthens the hollow branch or trunk as concrete would, but in exceptional cases, and where the apertures are large, broken bricks make an excellent substitute, and the cost is nil. Breeze or cinders are also used for mixing with the cement, but they are porous and admit damp.

Asphalt.—This has several points of recommendation, though its use may be said to be but imperfectly recognised. First of all, owing to its comparative elasticity, it slightly yields to the motion of the tree, while it is readily applied and is absolutely waterproof. So far, we have little experience of asphalt as a filling material for hollow stems and branches; but experiments in hand in various parts of London lead us to believe that it will in the future supersede concrete for that purpose. The cost, too, is not prohibitive.

Sawdust and Asphalt.—Where concrete is

too rigid, a mixture of sawdust and asphalt makes an excellent filling for hollow trees, particularly such as are growng in exposed situations and are apt to get swayed about by the wind. The materials are dry sawdust and solid asphalt, one part of the latter to four of the sawdust of oak or beech.

Fungicides.—Some of the larger-growing fungi that attack forest and other trees can most successfully be dealt with by carefully removing the growth and, after cleaning and dressing the wound, treating the affected stem or root with a suitable antiseptic. In the case of minute fungi, however, scraping or scrubbing the bark and wood and painting or spraying with a recognised fungicide will be sufficient.

Where the fungus has permeated the diseased wood of a tree, it is almost impossible to deal with the attack; but when it only occurs between the bark and wood, remedial measures may often be adopted. For the destruction of fungus spores nothing equals sulphide of potassium, also known as liver of sulphur, or copper sulphate. Sulphide of potassium in

the proportion of an ounce to three gallons of water is a valuable fungicide, in the case of both forest and fruit trees. In severe attacks of either fungus or aphis the proportion of potassium sulphide may be slightly increased. Copper sulphate, which enters into the composition of the now well-known and valuable Bordeaux mixture, is an excellent fungicide. It may be used in the proportion of three-quarters of a pound weight to ten gallons of water. The Bordeaux mixture contains, in addition, half a pound weight of fresh lime. Woburn wash, which also contains copper sulphate, is a valuable remedy for fungus attacks.

Great care is necessary in compounding these fungicides, too small a quantity of the more powerful ingredients rendering the mixture valueless for the purpose intended, while too great may do irreparable damage to bark or foliage. When small quantities only are required, it is preferable to purchase from some of the firms who make the preparation of such a specialty.

Insecticides.—These are many and vary greatly

in composition according to the insect pests against whose ravages they are to be applied. The Woburn wash is excellent for the American blight, while aphides of most kinds are quickly destroyed by paraffin emulsion in the proportion of one pint of emulsion to six gallons of water.

Then many of the advertised insecticides are most useful, but it would be invidious to mention names. Kerosene emulsion for caterpillars and aphides has few equals, and is readily obtained from nurserymen in a compound of paraffin and soft soap, to which only water requires to be added. Paris green, in the proportion of an ounce of the paste or powder to the same weight of lime and ten gallons of water, is a valuable insecticide. London purple, like the latter, is valuable for spraying fruit trees. Tobacco is also a most effective poison to aphis and other insects, but requires careful handling.

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